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DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

BIBLIOGRAPHY
OF
INDUSTRIAL DRYING

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VOLUME III

DECEMBER 1951

Price 27s 6d (3 Volumes)

The Bibliography of Industrial Drying is divided into five sections and presented for convenience in three volumes. A contents list for the relevant sections is included at the beginning of each volume and a list of sources quoted in the text, is given at the end of Volume III.

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" 2. Drying Processes and Equipment

VOLUME II. Section 3. Agriculture
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ADDENDUM 801

List of Sources referred to in the text.

SECTION 5 - INDUSTRIAL MATERIALS
GENERAL

Aggregates Etc.

1. Hopkins, L. C. — Institute of Fuel Paper given 3 Jan. 1951 pp. 1-4

AGGREGATES. The reasons for drying road stone are given, the methods and equipment (mainly rotary dryers) are described, and fuel costs given.

2. Fraas, F. — Amer.Inst.Min.Metall.Engrs; Tech.Publ. 2257, 16 pp.; Min.Technol., 11, No.6

DRYING (OF MINERALS) FOR ELECTROSTATIC SEPARATION OF PARTICLES. A discussion of the effects of varying amounts of H_2O or other liquids on the electrostatic separation of broken solids (e.g., coal from slate and shale). Permissible H_2O contents vary (0.75 - 3.5%) according to minerals and processes used; de-watering by drainage or filtration is not always efficient for coarse ores (10-35-mesh), e.g., siliceous fluorite, felspar- and calcite-quartz mixes, for which centrifuging is recommended. The centrifuge may be driven by steam or Diesal engines, the exhaust steam and waste heat being used for final drying. Comparative costs of drying by centrifuge and by evaporation (which is suitable for removing adsorbed H_2O and for coarse feeds having 2% of H_2O) are given. Recovery of the dielectric liquid (kerosene and/or nitrobenzene) in the dielectric-const. method of separating, e.g., siliceous-cassiterite at slime sizes, is best effected by displacement of H_2O in presence of a surface- active agent.

3. Burke Jacobs, P. — U.S. Dept.Agric.Misc.Publ. No. 695 Feb. 1950

INDUSTRIAL ALCOHOL. A study of the Technology, production and uses of alcohol in relation to agriculture. A few remarks on the distilling of alcohol and the drying of solids. D.S.I.R. 10/14/1.

4. Overman, I. J. — U.S. Pat., 2,411,751, 26/11/46

DRIER FOR AGGREGATES AND THE LIKE. Aggregate is passed through a rotating dryer with an inner and outer drum. At one end of the structure is a stationary closure with apertures through which aggregate is supplied to the inner drum and discharged from the outer drum. The flame of a burner heats the interior of the outer drum through an aperture in the closure, and a second burner heats the interior of the inner drum through a similar closure at the opposite end. The inner drum ends short of the outer drum at one end of the structure, and by this means the aggregate can be transferred from one drum to the other.

OD TECHNOLOGICAL RESEA

5. Thrower, L. N. Road Res.Lab. Note No. R.N./1447, May 1951, D.S.I.R.5920/C

AUTOMATIC TEMPERATURE CONTROL OF AGGREGATE LEAVING A CONTINUOUS DRYER BY MEANS OF A PROPORTIONAL CONTROLLER. This method gives more accurate control than a simple on-off controller.

6. Walthew, R. C. Institute of Fuel, Paper given 3 Jan. 1951 pp. 1-8

DRYING OF IRONSTONE. The advantages of drying ore before loading into the blast furnace are explained. Description equipment, either static or rotary dryers, with tables of performance data. Overdrying is dealt with and automatic control is suggested whereby a property of the exit gases, e.g. dust content, is applied to control.

Aluminium Salts

7. —— Metallgesellschaft A.G. Technical and Research Reports, No.1918 1.5.1942 B.I.O.S. Rept. No.335 p. 204

DEHYDRATION AND DECOMPOSITION OF ALUMINIUM SULPHATE.

8. Datin, R. C. U.S.P. 2,382,298 14.8.45
Solvay Process Co. B.I.202 March 1949

DRYING OF PEBBLED AMMONIUM NITRATE. A melt of Ammonium Nitrate containing powdered dolomite (39%) and water (4-6%) is heated at 110-133^{0} in an 80 ft. countercurrent air stream to give pebbles (40% retention on 10 m. sieve) at 50-70^{0}C. which are cooled to 25^{0}C. in a rotary drum with countercurrent air, at 20^{0}, to give 3-5.5% moisture, or with countercurrent air at 130^{0} to give pebbles of 0.3 - 4.0% moisture, (without case-hardening) in 50 mins.

Ammonium Salts

9. MacMullin, R. B. F.I.A.T. Final Rept. 718, Leuna. p. 7-8

AMMONIUM NITRATE. 95% Ammonium Nitrate liquor at 135^{0}C. is sprayed into the higher end of a rotating drum 6 ft. diam. 12 ft. long. Liquor is atomised by 60 lb. air pressure. Hot air is sucked into the drum behind the sprays at 100^{0}C. heated by steam at 75 lb. pressure. Diagram . The 99% salt at 90^{0}C. is then screened and cooled in a rotary drum. The incrustation on the dryer drum (10% of product) contains iron and is consequently redissolved for use in mixed fertiliser.

10. —— Sci.Libr.Bibl.Series No.267 1936

MANUFACTURE OF AMMONIUM PERSULPHATE. 14 Refs.

Animal by Products

11. Barton, J. N., Good, W. M. Inst. of Fuel "Drying Study" March 1951
DRYING OF ANIMAL BY-PRODUCTS. The methods of drying are discussed; by radiation, convection, by conduction, wet rendering, dry rendering, solvent processing and vacuum rendering. The drying of blood, fish offal is discussed and future trends of operation and design are suggested.

12. Bersoe, C., Fakstorp, J. Food Industries of S.Africa pp. 29-31, 47, May 1950
Vitamin Oils Ltd. (Cape Town) and the S.A. Council for S. and I. Res. have each installed a spray drying m/c for drying blood in abbatoirs. The essential feature is an atomiser wheel that produces minute particles of almost equal size, permitting gentle drying at comparatively low temperatures.

13. Hermitte, Raub, J. J. Ind.y.Quim. 9 135-143-1947 BIII. 185-7. 1948
BY PRODUCTS OF SLAUGHTERING INDUSTRY. Hides, skins, hair, fats and waxes, fatty acids and derivatives. Pharmaceutical products. Animal foodstuffs and fertilisers.

14. Lovern, J. A. Inst. of Fuel "Drying Study" March 1951
DRYING IN THE FISH-MEAL INDUSTRY. Materials are classified according to the oil content of the offal. Drying by total evaporation, (disadvantage of the sticky nature of the stock). The drying of press-cake. Direct heat dryers, include superheated steam dryers. Indirect heat dryers. Some data on the characteristics of the product.

15. Meat Board Abbatoirs, Cape Town Chem.Age. 5/11/49 61 1582, p. 647
New System of Spray Drying BLOOD instead of roller drying, which produces a coarse material only fit for fertiliser. The spray process will produce material for human consumption.

16. Slade, F. H. Chem. Products; 13 (5) p. 185 Apr. 1950
SPRAY DRYING DEVELOPMENTS. BLOOD. Short description of the appliance of Kestner spray dryers and blood for fertiliser and food and for blood plasma and serum.

17. Slade, F. H. J. Inst. of Heat and Vent.Engrs. 5/1948 21 No.251, p. 481
BLOOD. 99.9% soluble blood product for food or fertiliser. 2 methods. (1) Remove fibrin by stirring, then separate the red corpuscles, and spray dry the remaining serum. (2) Add stabiliser, e.g. citrate or oxalate, separate red corpuscles and dry the

remaining plasma or separate fibrin from the serum in the plasma by pptg. the fibrin. Plasma - 65% (Serum 55%, Fibrin 10%), Red Corpuscles - 35%. Plasma coagulates with heat; makes a good binder.

Art Treasures

18. Rawlings, F. I. G., Fletcher, P. — J. Inst. Heat and Vent. Engrs. 11 (120) 175-185, 186-200, 1943 Build. Sci. Abstr. 17 178, 1944

ART TREASURES, STORAGE. A discussion of the best methods of storage.

Asbestos

19. Wolochow, D., White, W. H. — Canadian J. Research, 1941, B.19, 49-55

ASBESTOS: MOISTURE LOSS ON HEATING. A report is given of investigations of the effect of temperature and time of heating on the loss in weight of chrysotile asbestos mill fibre, and on the subsequent sorption of moisture by the heated fibre. The results show that in the temperature range 500 to 700°C, the loss in weight depends on both the time and temperature. At other temperatures the loss is practically independent of the time. Prolonged heating at about 490°C. expelled about 25 per cent., and at 510°C. about 50 per cent. of the combined water. Complete dehydration occurred on prolonged heating at about 580°C., but only above 700°C. was the loss in weight rapid. On the basis of the data obtained on the resorption of moisture it is suggested that heating for half an hour at 215°C. would be a more accurate and rapid method for determining free moisture than that commonly employed.

Barium Carbonate

20. Lawrence, J., Peacock, R.B., Le Feuvre, C.W. — B.I.O.S. Report 1432 (Kali-Chemie Honningen)

BARIUM SALTS. Barium Carbonate slurry filtered on rotary vacuum filter, covered with cotton cloth. Details of speeds, etc. Cake containing 35% moisture is scraped off and conveyed to producer gas fired rotary dryers 42 feet long, 5.5 ft. wide. Feed end 1000°C. Exit 170°C. and dry product at 120°C. p.14. Barium Sulphate is dried in a somewhat similar manner.

Bark

21. Freiday, J. H. — Paper Tr.J. 1949, 128. Industr. Dev. Sect., 144-145

FLASH-DRYING BARK FOR BETTER BURNING. The Flash Dryer, consisting of a mixing mill and a separator, is actuated by 50% of the hot furnace gases, which are discharged at 400°F., the bark H_2O content being reduced from about 63 to 45%. The advantages include higher thermal efficiency and reduction in the size of boiler equipment.

22. N.E'n Wood Utilisation Council. Rept. Paper Tr.Jrl. 128 (18) 21-22, 5 May 1949
THE DRYING OF BARK. The Economics of Drying and the Applications of Dried Bark.

Bauxite

23. Finkey, Joszef Banyasz Kohasz Lapok 64 445-50, 468,73 1931 C.A.26 1718 1931
DRYING OF BAUXITE. Experiments on the drying of Bauxite of 17% moisture. The heat required for the four stages to 530°C. were determined. The total heat was 582,130 cals. per metric ton. The ore, after drying at 530°C., took up 5-6% moisture during standing for 4 weeks. Repeated drying at 105°C. reduced this to 1.5%. Thus the drying of bauxite does not seem economical.

Blood Serum

24. —— Discovery March 1947
Spray drying of blood left too much water, and storage properties were therefore bad. The drying temperature should be below 70°C. Attempts to distill off water caused frothing. At the end of the 19th century inferior quality dehydrated serum was obtained, but the process was slow at temperatures low enough to stop frothing.
There was little development of freeze-drying between 1909 and 1931, when dry ice enabled -78°C. to be maintained.
1000 litres of blood per week were called for in 2nd world war. The Stokes diffusion pump enabled pressures to be maintained down to 0.1 m.m.

25. --- O.S.R.D: U.S.2,441,730 18 May 1948 Chem. Abstr. 42. 4805, 1948
High Vac. shell freezing and drying apparatus. Description of improved process.

26. Anon. Chem. Inds. p. 402, Sept. 1948
Danes and Swedes use Spray drying for blood plasma. See under "Spray Drying, Danish Serum Institute."

27. FREEZE DRYING OF BLOOD.

Refrig. Engg. 49.4.282.322-4.1945	Belsky, G. A.
J. Immunology. 50.21-54.1945	Flosdorf, E. W.
Refrig. Engg. 47.1.33-9.1944	Kendrick, D. B.
Chem. Eng. News. 23.714-717.1945	Stenerson, H. W.

28. Campbell, D.H., Pressman, D. Science 99 285-6, 1944
LYOPHYLE PROTEIN EVAPORATION APPARATUS. A laboratory appliance is described where material is frozen in pear shaped flasks and frozen with dry ice, connected to a condenser, cooled with dry ice and

cellosolve. A gauze screen prevents mechanical loss from very dilute solutions and causes no appreciable diminution of rate. Complete dryness achieved in 5 hours. Flask warmed if necessary.

29. Cutter Labs. Berkeley Calif. Chem. Inds. 7/1948 63, (1) p. 38
Short Description of freeze drying process.

30. Flosdorf, E. W. Chem. Eng. Progress 43 343-8 July 1947
See under "Freeze Drying".

31. Flosdorf, E. W., Stokes, F. J. J. Amer. Med. Ass., 1940, 115, 1095
Mudd, S. Chem. Abstr., 1940, 34, 7957
THE DESIVAC PROCESS FOR DRYING FROM THE FROZEN STATE. Claims that the desivac process has advantages over the lyophile and cryochemical processes in large-scale operations for preparing plasma or serum. The theoretical basis for this is the higher critical pressure permissible with increasing efficiency of removal of water vapour. The desivac process, which meets such requirements, depends on the use of pumps of large volume capacity, in which the sealing oil circulates and is freed from water by a continuously operating centrifuge. The clarified oil is returned to the high vacuum side of the pump. In this way water vapour is withdrawn from the high vacuum space. The system, therefore, operates efficiently at 4.5 m.m. of mercury and still permits the substance to remain in the frozen state by loss of latent heat by evaporation. The final residual moisture in the material is below 1%.

32. Greaves, R.I.N., Adair, M. F. J. Hyg., Camb., 1939, 39, 413
HIGH VACUUM CONDENSATION DRYING OF PROTEINS FROM THE FROZEN STATE. Methods are described for the preservation by desiccation from the frozen state of large volumes of protein, both in bulk and in ampoules. The principle is one of high vacuum condensation drying, using liquid air for quantities up to 250 ccs. or refrigerator evaporator coils for quantities up to 5 litres. Desiccators, not manifolds, were used throughout. Use is made of an accurate automatic control of heat to the frozen material. By recording this heat input, a visual record is obtained, indicating when the end-point of desiccation has been reached and, from this record, it is possible to calculate the approximate percentage dryness of the material at any period of desiccation. The control of the apparatus is such that, within stated limits, the conditions of desiccation can be altered at will. Obstruction to the flow of water vapour is so small that plugged containers may be used, in order to prevent contamination of material during drying. Suggestions are made for designing forms of apparatus to meet various requirements.

33. Greaves, R. I. N. J.Amer.Med.Assn. 124,76, 1944
Production of blood derivatives to meet War requirements in Britain.

34. Greaves, R. I. N. Medical Res. Council Special Report Series No.258 H.M. St.Off. 1946
THE PRESERVATION OF PROTEINS BY DRYING.

35. Greaves, R. I. N. J.Hyg.Cambr. 41 489 1942
THE FREEZING OF HUMAN SERUM AND PLASMA IN MEDICAL RESEARCH COUNCIL TRANSFUSION BOTTLES, BEFORE DRYING BY SUBLIMATION FROM THE FROZEN STATE.

36. Greaves, R. I. N., Adair, Muriel E. J. Hyg.Cambr. 36 507 1936
A simple method for preservation of sera by desiccation in the frozen state without the use of refrigerants.

37. Lanyon, E. C. G. J.Hyg.Cambr. 41 111 1941
AN APPARATUS FOR SPIN FREEZING SERUM OR PLASMA IN CIRCULAR BOTTLES.

Caustic Soda

38. Badger, Monrad and Diamond A.I.Ch.E. Trans. 24 56-78, 1930 Ind. Eng.Chem. 3 rep. 22 700-7 1930
CAUSTIC SODA. Evaporation of Caustic Soda to high concentrations by means of Di-Phenyl Vapour.

Cellulose Acetate

39. Brown, F. S. C.I.Q.S. Report No.37-23
PRODUCTION OF CELLULOSE ACETATE FLAKE. Centrifuged solid is blown to a vacuum dryer about 25 ft. long, 5 ft. diam. with dished ends, holding 1,000 Kilos. Four hours required to dry to 2% moisture from the original 68%. 1 Dryer dries 80 tons per month.

40. Diamond, C. B.I.O.S. Report No.1204
CELLULOSE ACETATE. p.9. Vacuum Tray Dryers, at 70-30 m.m. mercury pump. A low vacuum of 20 m.m. at the end was produced by a steam ejector. Final moisture was 1% - 2.5%.

41. Hasthe, R., L., Boundy, R. H. C.I.O.S. Report 26-75
PRODUCTION OF CELLULOSE ACETATE. p. 5. Product from centrifuge at 65% moisture, is blown into a rotary vacuum dryer of aluminium of double hopper type with internal and external heating.
10-20 m.m. vacuum is used 6 hours at 70^{0}C. to dry 500-600 Kilos to 1-2% m. Dryer by Deutsche Vacuum Ges. Erfurt.

42. Purnell, W. E., Clark, W. B. Hughes, H. R. B.I.O.S. Report No.1600 pages 20-1
Cellulose Acetate flake, dewatered by centrifuge, is dried in a horizontal cylindrical vacuum dryer. Details of temperatures, time, output, etc. I.G. Farben, Dormagen. 3 illustrations of dryers.

43. Taniguchi, Masakatsu J.Soc.Chem.Ind.Japan, 44 953-5 (1941) Chem.Abstr.43 (6) 2427, 25/3/49
FREE SULPHURIC ACID PRODUCED IN THE COURSE OF DRYING ACETYL CELLULOSE. Drying Temperature has the largest influence. See long abstract in Chem. Abstracts.

Cellulose Regenerated

44. Feubel, A. and Hilgers, F. (Melliand Textilber,1948,29,233-235)
DECREASING SWELLING OF REGENERATED CELLULOSE HYDRATE FIBRES BY DRYING PROCESSES AT NORMAL AND ABNORMALLY HIGH TEMPERATURES. Uneven drying of viscose and cuprammonium rayon yarns causes differences in d which give rise to uneven swelling and dye affinity. A micro-staining technique is described and has been used to investigate the effects of drying on solubility and swelling. "High-temp. cellulose" of high d, with swelling no greater than that of cotton and unchanged tensile properties, has been obtained by drying, e.g., for 30 sec. at 260°, in glycerol in absence of O_2. The decreased swelling val. is unaffected by washing. Fibre damage occurs only if the duration of heating is too great.

45. Matthes, A. Kolloid-Z.,1944,108,79-94 (through Chem. Abstr.,1946,40,76099)
REGENERATED CELLULOSE FIBRES: GEL STRUCTURE. The swelling of cellulose hydrate is considered as a special case of adsorption, and is discussed at length, following a consideration of the sorption isotherms of active carbon and cellulose hydrate. The isotherms of cellulose hydrate were subjected to mathematical analysis, and the calculated values for adsorption were found to agree very well with the observed values until a relative humidity of about 50 per cent. had been reached. Thereafter, the discrepancies became magnified with increasing relative humidity and were found to be due to condensation of water in the capillaries of cellulose hydrate. Sorption in the case of cellulose hydration is ascribed to water (a)held in solid solution, (b) held by adsorption, and (c) condensed in the capillaries. These three forms of sorption are discussed.

46. Wardenburg, F. K. C. duPont Rayon report ME 76 Final Report on Mx152
APPLICATION OF "YENKEE" DRYER TO CELLOPHANE. Study of Cellophane dryer. Nov. 1931 - May 1932.

47. Welder, F.C., Amer Viscose Corp. U.S.P.2,444,124 29.6.48 B.II. 334 Apr.1949 Chem.Abstr.43 (18) 7042 9/1948

FREEZE DRYING REGENERATED CELLULOSE. Dimensionally stable cellulose articles having an extended porous sponge-like structure which is not materially altered by moisture, are prepared by exposing freshly pptd. regenerated cellulose to a temperature of less than $-70^0C(CO_2$ and Acetone) so as to freeze quickly the H_2O present. Treated in vacuo, which is maintained until a comparatively high temperature is reached, thus ensuring complete removal of water.

Cement

48. Anon. Zement 23, 51-2,1934

SLURRY DRYING BY THE FULNER ZIEGLER A. G. PROCESS FOR IMPROVING THE HEAT ECONOMY IN WET PROCESS ROTARY KILNS. Chains are suspended in the kiln by one end so that they hang vertically downward during a part of the revolution and thus form curtains on which the slurry is sprayed.

49. Anon. Rock Prod., 37,66,1934 May

SLURRY DRYER AND PREHEATER FOR CEMENT FEED KILN.

50. --- Pit and Quarry.1945 Nos.2-5,71-74 76-78 83-86 91-93 95 Ceram.Abstr.29 49 1946

THEORY AND PRACTICE OF ROTARY KILN OPERATION IN THE MANUFACTURE OF PORTLAND CEMENT. The fundamentals of cement manufacture are first discussed, include chemical composition, latent and specific heat, kiln fuels, and calculations of heat and heat losses. Next the composition of clinker made from limestone and clay are considered. Heat transfer in rotary kilns and heat transfer efficiency, shape of kilns, and kiln operation, are assessed at length. The burning zone, rate of coal delivery, air ratio air temperature, coal fineness and coal dryness, and volatile matter are also discussed.

51. Ass.Pt.Cement Mnfrs. B.P.598,355/Appl. date 9 Mar.1944
Dawson, C. B.

APPARATUS FOR DRYING SLURRY. Comprises a slurry container through which passes a conveyor carrying plates; these pick up a film of slurry, which at a later stage is brought into contact with drying gases and then removed with scrapers.

52. Bauer, W. G. Cement and Lime Mnfr. 23 2.33-7 1950

FLUIDISATION APPLIED TO THE LIME AND CEMENT INDUSTRIES.

53. Blank, A. J. Concrete, vol.39, No.5, Nov.1931, pp. 49-52, 4 figs.
MAJOR DUST LOSSES IN DRY PROCESS CEMENT PLANT OPERATION. Amount of dust loss in driers; plans and cross-sections of kiln and drier dust chambers; burning of raw cement mixtures; dust losses from driers and kilns in new installations; dust chambers soon pay for themselves.

54. Clegg, L., Jackson, S.V. Inst. of Fuel, "Drying Study" March 1951
THE DRYING OF PASTES, POWDERS AND CRYSTALS. CEMENT. A heat balance is given for two cement kilns.

55. Goentgen, K. Zement 22, 582-5 (1933)
SLURRY DRYING WITH THE MIAG ANALYZER. Twice used to convert the slurry by means of work heat into granular mass.

56. Laeger, H. Tonind. Ztg.1175-7 (Oct.17,19, 1931)
MEAL DRYING FOR CEMENT RAW MATERIALS.

57. Miething, E. Zement v 22 n 9 Mar.2 1933 p. 121-2
DER AUSTROCKNUNGSVORGANG IM BETON. Drying process in concrete; results of elementary tests to give insight into moisture content of different layers of fine concrete bodies with different drying methods.

58. Polysius, A. G., Dessau Zement 22, 355-7 (1933) June 29
SLURRY DRYING IN THE CEMENT INDUSTRY.

59. Schirm Cement and Cement Manuf. 7, 29-44 (1934) Feb. Extension of abst. this Bull., No. 1 p.13
KILNS: AN EXIT TEMPERATURE OF 100°C. WITH THE WET PROCESS. The original paper is an extended discussion of types of slurry dryers and preheaters, heated by waste gases from the kiln. The lowest flue gas temperature attainable by placing chains, onto which the slurry is sprayed, within the stack end of the kiln is 250°C. Lower temperatures can be reached by causing the flue gases to pass through the drying slurry, as, for example by providing a series of slanting screens so that the slurry cascades from one above to the next below, while the flue gases pass upward successively through each screen. In this way the upper screens are so wet that dust rising from those below is largely caught. To prevent clogging as the slurry dries, steel balls or rods may be fed with the slurry down the staircase of screens. The balls are separated from the powder before the entrance to the kiln and returned hot to the top. Here they pick up much of the fresh slurry on their hot surfaces and maintain a sufficiently porous mass to permit the passage of the gas. In place of the steel balls, a portion of the burned clinker may be recirculated uncooled to the slurry dryer. The clinker can, of

course, pass on through the kiln with the raw feed. Another variation is the device mentioned in this Bull. No. 16 p. 13, which is essentially a rod mill with a perforated shell.

60. Swayze, M.A., Davis, C.G.J. FIAT Final Rept. 519 26 pp.
THE GERMAN CEMENT INDUSTRY. Contains brief notes on drying in rotary dryers or combined drying and grinding. Use of waste gas from rotary kilns and recirculated air from cyclones.

Chalk

61. Clegg, L., Jackson, S.V. Inst. of Fuel. "Drying Study" March 1951
THE DRYING OF PASTES, POWDERS AND CRYSTALS. CHALK. Pneumatic drying with dry recirculation 2 of dry to one of wet material. A heat balance is given.

Chemicals

62. Becker Chem.Met.Eng. 38.94-6(1931)
DRYING THE OUTPUT OF THE CHEMICAL PLANT.

63. Link Chemiker-Zeitung, 55, No.80, Oct.7, 1931, pp. 772-774. 11 figs. See also Ind. Chemist 7 472-3 (1921)
NEUE TROCKNUNGSEINRICHTUNGEN FUER CHEMISCHE PRODUKTE (NEW EQUIPMENT FOR CHEMICAL PRODUCTS).

64. White, A. S. Fuel and the Future 1948 pp. 988-9
THE DRYING OF CHEMICAL PRODUCTS BY THE ATMOSPHERIC TRAY DRYER.

65. Young, K. W. Report C.I.O.S. XXXIII - 31 150 pp.
INVESTIGATION OF CERTAIN CHEMICAL FACTORIES. The drying of:-
1. Chlorine - by 66^{O}B. sulphuric acid.
2. Pot. Chlorate - Hot air.
3. CO for Phosgene - Silican Gel.

Coco Fibre

66. Buck, Lucien Chem. & Met.Eng. 29 626 (1932)
COCO FIBRE. Regular line with humidity chart, etc. Plot of wt. vs. time for material 1 in. thick on wire bottom trays at different temperatures 220-280^{O}F. Drys twice as fast at 280^{O}. considerable const. rate period indicated. Curves also for laboratory and plant test on drying of coco fibre mats. Table shows overall figures for heat loss through various dryer housings (Courtesy Johns-Mansville). Sample calculation of heat and air requirements for coco fibre mat dryer: 170-210^{C}, 10 hours total, dry 8.25 to 5.50 lbs. per mat.

Crystals. Pastes

67. Aktieskab, Volund Braback, J. B.P. 612,090 17.9.46 B.I. 333 May 1949

DRYING OF PASTES. The paste is spread in a thin layer on a heated conveyor belt. Air at room temperature is blown in through a number of slits above the conveyor and at right angles to it. A long period of contact between solid and air is achieved.

68. Barr, P. J. B.P. 624,812 6/47

DRYER FOR PASTY MATERIAL. The material is extruded through an endless band which is perforated, and the extrusions are then dried while still adhering to the band. They are shaved off when dry.

69. Clegg, I., Jackson, S.V. Inst. of Fuel "Drying Study" March 1951

THE DRYING OF PASTES, POWDERS AND CRYSTALS. The paper classifies the types of dryers used for drying the above under the headings contact and convection dryers, and describes the technical features of each dryer. Heat balances are given for drying the following:-

Phosphate Fertiliser
Ammonium Sulphate
White Lead
Cement
Chalk
Sugar-Starch Syrup Extract.
China Clay
Lithopone
Soap

70. Kay, A. W. Inst. of Fuel "Drying Study" March 1951

DRYING OF POWDERS AND CRYSTALS IN THE PHARMACEUTICAL INDUSTRY. Shews the necessity of removing traces of surface moisture before mixing with other pharmaceuticals. Describes in general terms, oven, rotary, vacuum drying, shews the application of infra-red heating to the drying of thin layers of bi-carbonate, and the high capital cost of high frequency drying. Particular reference to the methods tried for magnesium sulphate, and shewing how pneumatic drying was eminently suitable for reducing the moisture content from 57% to 25% for storage purposes.

71. Loeser, C. Sprechsaal 63 No. 5 and 6(1930)

PASTES AND THEIR BEHAVIOR ON DRYING.

72. Ambler, C. M. Chem. Eng. Progr. 44 (5) 1949 Trans. Amer. Inst. Chem. Engrs. 405-410 1948

AN ATTEMPT TO DEVELOP A THEORY OF CRYSTAL DRYING.

73. Heastie, B. Engineering 135, 686, (1933) June 23
CENTRIFUGAL DRYER FOR CRYSTALLINE MATERIALS.

Diatomite

74. Déribéré, M. L'Industrie Chimique, 32, 259, 1945
THE DRYING OF DIATOMITE BY INFRA-RED RAYS. It was found that dry diatomite behaves rather as a reflector of infra-red rays. However, the wet powder is far more absorbent, and if infra-red drying is used the high reflectivity will become operative only towards the end of the drying operation. Since diatomite is so poor a conductor of heat it must be spread in thin layers if it is to be dried economically by this method; it was found that the optimum thickness of such layers is 3 cm. A drying tunnel 33 ft. long and 3 ft. wide operating for 12 hours daily should dry over 2 tons of diatomite a day, from an initial water content of 40% to a final water content of 5-8%. It is estimated that the power consumption would be 62.5 kw. Trials have shown that drying at 60°-70°C. with infra-red lamps is more rapid than drying at 80°C. with hot air.

Dyestuffs

75. B.I.O.S. Report No.959 102 pp.
I.G. FARBENINDUSTRIE. p.53. Notes on drying dyestuffs.

76. Marsden, L., Sachs, G., Swenson, J. C. B.I.O.S. Report No.1141
GERMAN DYESTUFFS.

p. 19.	Double Drum Dryer. Diagram.
p. 35.	Tray Dryers.
p. 63-4.	Newbiloso Spray Dryer.
p. 65.	Venuleth Rotary Dryers.
p. 115.	Single Drum Dryer.
" "	Tunnel Dryers.
" "	Buttner Turbo-Dryer.
p. 151.	Double Drum Dryer.
" "	Venuleth Dryer.
175-177-178.	Documents on Venuleth Dryers.

77. Avery, J. et al. B.I.O.S. Report No.1157 pp. 7 & 25
GERMAN DYESTUFFS. Many colours previously vacuum dried at 90-95°C. are now dried on the double drum drier. The colour remains on the dryer for 20 secs. at 155°C. and is peeled off by overlapping knife edges. The original second stage of dropping the colour from the drum into a warmed tube with worm agitator is found unnecessary. A condenser was fitted to prevent specks of colour from flying away and becoming a nuisance. The dryer was not suitable for very small quantities.

78. Chamberlain, K.A.J. et al B.I.O.S. Report, No.1548 pp. 8-9
MANUFACTURE OF OZO AND LAKE DYESTUFFS. (1) Drum Drying of Paste. (2) Vacuum drying of press cake on trays. (3) Tunnel drying of press cake on trays. (4) Hot air ovens. Temperatures, outputs, and costs, are given. No Diagrams. No substantial information on drying in the remainder of the report.

Electrical Materials

79. --- Armour Res. Foundation Ann. Report p. 33. 1948
ELECTRICAL INSULATORS. DRYING METHODS. Projects for best methods for drying insulating materials. Comparison of methods to determine dryness.

80. Foote, N. M. Ind.Eng.Chem.,1947 39, 1642-1646
PAPER: VACUUM DRYING. The sorption of water by tissue paper used in the manufacture of rolled electrical capacitors and the decomposition of the paper have been studied under conditions comparable with those present in impregnation precesses. Decomposition accompanies severe drying and at high temperatures supplants the final drying. The interrelation of these processes and their effect on the electrical insulating qualities of paper are only imperfectly understood. A method of estimating the minimum load presented to a vacuum pump by such sorptive systems is given. There are 31 references to the literature.

81. Hall, A. G. Bell Laboratories Rec 13 No.10 June 1935 p. 312-7
DRYNESS IN TELEPHONE CABLES. Equipment for improved method of drying cable installed by Western Electric, in which drying of cable cores in vacuum replaced drying at atmospheric pressures; vacuum tanks operated at temperature of 270 F; row of tanks used in drying illustrated.

82. McIlwraith, A. T. Electr.World 126 150. 14.9.1946
BATTERY PLATES DRIED WITH INFRA RED LAMPS.

83. Klucker, Paul, German P. 735,365
Siemens-Schuckert Werke. A.G. Apr.1943 Chem.Abstr.1944 2574
DRYING OR VULCANISING ELECTRIC CABLES IN A HIGH FREQUENCY FIELD.

84. Ledoux, E. Electricité 21 No. 30 Mar 1937 p. 129-31
L'AIR SEC DANS LE DOMAINE DE L'ELECTRICITE. Notes on usefulness and application of dry air in electric industry in manufacture of cables, condensers, dehumidification of stockrooms, paint spraying, etc.

85. Pirie, A.W., Valentine, W. B.I.O.S. Report No.1326
GERMAN VULCANISED FIBRE INDUSTRY. Some details of information on drying.

86. Willis, M.E., Daltroff, M.L. Electr. World 135 7. 108 12.2.1951
DRYING OUT TRANSFORMER INSULATION WHILE UNDER LOAD. By circulation of inert gas under pressure and absorption of water vapour.

Enamelling

87. Aldinger, R. Keramische Rundschau v 43 n 11 Mar.14 1935 p. 119-21
DIE TROCKNUNG IM EMAILLIERWERK. Drying in enamelling plants; suggestions for choice of drying methods and equipment.

88. Marbaker, E. E. Ceram, Forum, 13, No.1, 5; No.2, 2,1946
THE TECHNICAL ADVANCEMENT OF THE SHEET-STEEL PORCELAIN ENAMELLING INDUSTRY. Flocculents act upon clay holding the enamel in suspension and particles of enamel itself so that flowability may be regulated. Borax is usually the setting agent, but if the ware rusts badly ammonium carbonate or sodium nitrate is used. Cover coats are usually set up with a small amount of magnesium carbonate. The most desirable method of drying is by the application of heat to the back of the article concerned, but this is not possible with hollow ware. Cracks through differential contraction of enamel layers may be avoided by use of a high clay content and coarse milling, although the gloss suffers to some extent. Infra red drying has been proved rapid, uniform, efficient and economical. In firing supports for the ware are made of heat-resisting ferrous alloys which do not warp, and provide good thermal efficiency with relation to the weight of the ware. Ground coats are fired at 800^{0}—880^{0}C., and cover coats at 790^{0}-840^{0}C., and the periods of firing are one to four minutes and one to three minutes respectively. The atmosphere of enamelling furnaces must be free from dust, sulphurous gases and water vapours. In drying, the water in the ground coat oxidises the iron to ferric hydroxide, which changes to the black oxide and finally dissolves in the enamel glass during firing.

89. Anon. Cer. Industry v 29 n 3 Sept.1937 p. 166 and 191-2
INCORPORATE NEW PRODUCTION METHODS IN MODERN ENAMELLING PLANT. Procedure at Sunbeam Electric Manufacturing Co., Evansville, Ind, using open flame gas drier in pickle room, waste heat from radiant tube furnace helps heat tunnel drier; reclamation of enamel from water; pan spray booths.

90. Pickwell, P. G. Foundry Trade J. v 55 n 1059 Dec.3 1936 p. 436-7

PRINCIPLES AND PRACTICE OF DRYING ENAMELLED WARE. Drying as applied to vitreous enamelling Industry; drying processes, drying rooms, and conveyor systems, including mechanized cable conveyor system, described.

91. Pickwell, P. G. Foundry Trade J v 56 n 1064 Jan.7 1937 p. 14 and 16

DRYING OF ENAMEL WARE. Discussion of paper before Inst Vitreous Enamellers, Indexed in Engineering Index 1936 from Issue of Dec.3 1936.

92. Vielhaber, L. Bor. der Duetschen Keram. Ges. 27 310-13 9/1950

DRYING INSTALLATIONS IN ENAMEL WORKS.

Explosives

93. Bowden, et al Industrial Chemist 8/1948 p. 531-2-4

HEXAMINE DRYER. Short illustrated description.

94. Davis, Tenney L. The Chemistry of Powder and Explosives 1943 pp. 304-5

SMOKELESS POWDER. Formerly solvent was removed by warm air at 55-65^{0}C. and recovered, but the colloid tends to form a skin. Later process avoids this. The process is to immerse the powder in water at 65^{0}C. to remove the ether and alcohol, and then dry in a tunnel at 55-65^{0}C. to an equilibrium moisture content, varying from 0.9% to 7.5% for total residual volatile matter, according to web thickness.

95. Meyer, Martin
Brooklyn College
The Science of Explosives, T.Y. Cromwell & Co. N.Y.

SMOKELESS POWDER. p.215. Solvent recovery. 3 types of equipment but always case hardening occurs if dried too fast.
p.216. Drying. Two methods (a) Closed air circuit. (b) Water Drying. (a) takes weeks at graded temperature on account of solvent. (b) removes solvent in a few days at similar graded temperatures and drying in a tunnel or conveyor system in a few days or 1 day respectively. Total Volatile standards for various sizes, 3.5 - 7.5% of which actual moisture varies 0.9% to 1.4%.

96. Marshall, A. Churchill. 1917

EXPLOSIVES. BLACK POWDER. pp 83-84. After Corning and glazing, it is dried on canvas trays in a chamber heated by low pressure steam (pipes) at 40^{0}C. for 1-4 hours (according to size) to 1-1.5%. This is in equilibrium with normal atmospheric humidities.

97. Marshall, A. Churchill 1917
EXPLOSIVES. p.279. Picric Acid. The crystalline mass is filtered, washed by suction with alcohol and vacuum dried.

98. Marshall, A. Churchill 1917
EXPLOSIVES. Cordite gives off its moisture so readily that a few days at 15°C. for small sizes or a fortnight at 38–43°C. in a reasonably dry room is all that is necessary to reduce the moisture content to a low value. (It has been shewn elsewhere that cordite contains from 0.2% to 1.0% when in equilibrium with air at very low and very high R.H. respectively.)

Feathers

99. Oakley, R. C., Oakley, M. M. B.P.605,082 of 15/7/1948
FEATHERS: DRYING. Moist feathers are placed in a permeable bag which is supported in warm air, the lower part of the bag being continually raised and lowered by means of a contacting plate which moves up and down, allowing the feathers to dry without being broken or crushed. The plate may be heated by means of a gas burner. The neck of the bag may be secured to a pipe through which heated air is passed to the interior of the bag. After drying, the feathers are steamed, and any condensed steam dried by a stream of hot air, the disturbance being continued throughout.

Felt (Roofing)

100. Hoeltzal and Lyon Southern Pulp and Paper Mnfr. 11 5. 56–7 64 1948 B.I. 555 Oct.1948
FELT (ROOFING). Infra-red Gas heat, to increase roofing felt production. Efficiency of process.

Fertilisers

101. Anon. Coke, Aug.1946, 8. 169–70, 179
DRAINING AND DRYING AMMONIUM SULPHATE. A description is given of an improved installation for the mechanical drying of sulphate of ammonia, manufactures by the Chemical Engineering and Wilton's Patent Furnace Co. Ltd., and installed recently at the Birmingham works of Brotherton and Co. Ltd. The continuous extractor and vacuum draining equipment handles the sulphate automatically at a steady and continuous rate direct from the saturator to the final drier.

102. Clark, H. L. Wisconsin Engr. 36, 18 (1931), CA 26, 2016 (1932)
SODIUM NITRATE SPRAY DRYING. Production of spherical grains of sodium nitrate. Nitrate melted and pumped to tanks and thence to spray nozzles. In falling a distance of about 40 feet it solidifies into spherical grains 1/32" - 1/16" dia.

103. Clegg, L., Jackson, S. V. Inst. of Fuel DRYING STUDY March 1951
PHOSPHATE FERTILISER. THE DRYING OF PASTES, POWDERS AND CRYSTALS.
Use of direct rotary dryer. The wet material was delivered from the conditioner in small granules and left the final screens with 5% moisture. Parallel flow. Heat balance given.

104. Clegg, L., Jackson, S. V. Inst. of Fuel DRYING STUDY March 1951
AMMONIUM SULPHATE. THE DRYING OF PASTES, POWDERS AND CRYSTALS.
Dried in gas fired rotary dryer, direct, counter current flow. Heat balance given.

105. van Krevelen, D. W.
FERTILISERS. See under "Rotary Dryers".

106. MacMullin, R. B. F.I.A.T. Final Report 718
FERTILISERS BY I.G. FARBEN IND. Ammonium Sulphate. After crystallisation, the crystals are dried to 0.8% moisture by blowing warm air through the conveyor system. For future operation a rotary dryer would be preferred to reduce the moisture to 0.4%. Ammonium Nitrate. Liquor is evaporated to 95% and sprayed into a rotary dryer where 10% of the solid sticks to the drum and has to be scraped off. Leuna Saltpeter. Ammonium Nitrate and Ammonium Sulphate. Dried to 0.3% M. in a rotary dryer.
Kalk-Ammon-Salpeter. The distinctive feature is a centrifugal spray bucket with side walls perforated and mounted in the centre of the top cover of the large chamber. The material is removed from the floor by a plough. Nitrophoska (K.N. PO4). The moist product from the granulator is dried in a rotary, furnace fired dryer with Carbon monoxide gas obtained as a by-product. The exit gases at 30% R.H. and laden with dust, pass to a cyclone. 1.75 to 2.0 tons of water evaporated per hour at full fan capacity.

107. Sherwin, K.A., Steventon, J.W. Joint Meeting, Jan. 1949 of S.C.I., Chem.Engg. Group and Agric. Group
SOME CURRENT PRODUCTION PROBLEMS AND DEVELOPMENTS IN THE GRANULATION OF COMPOUND FERTILISERS. 1. Addition of water to promote granular form. 2. Dryer and Rotary cooler performances. Dust, and high efficiency cyclones. Stock piling of bags.

Gelatin. Glue

108. --- Food Manfr. 1948 23 5. 197
DESCRIPTION OF FACTORY OF R. HODGSON & CO. LTD. BEVERLEY, YORKSHIRE.
Extract is evaporated to 10-40% water. The cooled liquor run on to glass slabs or belt, cut and dried on wire mesh in a tunnel. Capacity of conveyor (automatic drying plant) is 300-350 gallons per hour.

109. Anon. Chem. Age 25.2.1950 62 (1598) 291-2
GELATIN AND GLUE RESEARCH. Liquor is concentrated by evaporation, the viscous solution bleached and p.H. adjusted. Set to jelly, cut into cakes, passed through a tunnel dryer to remove remainder of the water, (or the solution can be run on to a chilled stainless steel belt). Ground afterwards for blending.

110. Barkas, W. W. Forest Prod. Res. Bd. Nov. 1949. D.S.I.R. 2505. C.
THE CENTRIFUGING OF GELS. Deals with mositure changes due to molecularly bound water and capillary water. The latter may change considerably with small drop in vapour pressure, which may empty a considerable capillary volume even very near saturation.

111. Cole, R. J. Food Manufr. 24 155.8 1949
DRYING OF SOLID GEL FOOD PRODUCTS. The salient features of the drying theory are explained and the applications of theory and experiment to improving the efficiency of dryers are discussed.

112. Freundlich Kapillarchemie Band II 4th Impr., p. 581 1932
The vapour pressure isotherms for many gels are given by Katz.

113. Grover, D.W., Hallas, C.A. Br. Food Mnfrg Ind. Res. Assn. Res. Paper, No.20 May 1951
THE STOVING OF CONFECTIONERY. II. Preliminary Experiments on the Rate of Drying of Gelatin Type Jellies. An uniform content was reached in a given time irrespective of initial moisture content (in sugar - gelatin jellies).

114. Hermans, P.H., Hermans, J.J., J. Polymer Sci., 1947 2, 632-636
Vermaas, D. and Weidinger, A.
CELLULOSE GELS: CHANGES IN ORIENTATION ON DRYING. The orientation of model filaments (viscose) stretched to various extents in three different states of swelling was investigated by quantitative X-ray analysis before and after drying. The change in orientation on drying was found to be either very small or zero. This shows that the crystallites do not even approximately follow the rules of affined transformation which would require a very considerable increase in orientation on drying. There must be an entirely different mechanism which prevents the crystallites from being dragged along with the matrix in which they are embedded.

115. King, G.
THE SWELLING OF COLLOIDS. See under " Textiles".

116. Knock, C. Paul Parey Berlin 1928
DAS TROCKNEN KILLOIDEN FLUSSIGKEITEN INSBESONDERE DER MILCH.
(THE DRYING OF COLLOIDAL MATERIALS WITH SPECIAL REFERENCE TO MILK). A critical discussion of the apparatus for large scale drying of fatty and protein material described in general and patent literature.

117. Lloyd, D. J., Pleass, W. B. Br. Leather Mnfrs. R.A. Reports 1927-1941 Biochem Jnl. Vols. 21 to 25 1927-to 1931
THE ABSORPTION OF WATER BY GELATIN. Parts 1 to 7. The influences of various factors including electrolytes are treated in the successive parts.

118. Lloyd, D.J., Moran, T. Proc. Roy. Soc. (A) 147 382 1934
PRESSURE AND WATER RELATIONS OF PROTEINS. The object of the work was to obtain a measure of the forces holding the separate increments of water to the gelatin molecule.

119. Luther, R. Trans. Farad. Soc. 19 288-9 1923
THE DRYING VELOCITY OF GELATIN. A brief treatment of the four factors in drying coated plates (1) Vaporisation from surface (2) Consequent cooling and decrease of partial pressure. (3) Migration of water within the gel. (4) Shrinkage. In consequence of skin formation, there should be a minimum time of drying. The shortest air drying time was 40 mins. for an evaporation of 80 mg. water per sq. cm. of film, 8% gelatin. A more rapid drying requires a great expenditure of power and air.

120. Sheppard, S.E., Elliott, F.A. J.A.C.S. 44, 373 (1922)
DRYING AND SWELLING OF GELATIN.

121. Stevens, F.M., Hall, D.B. B.I.O.S. Report No.1101
THE GERMAN BORE GLUE INDUSTRY. pp. 5, 10, 11. 40% glue liquor at 50°C. is fed by 180 cocks to an 8 ft. long x 3 ft. diam. roller cooled by brine at -10°C. Thus the glue gelled into 180 ribbons 1/16 inch wide which were detached over a serrated rubber roller on to a galvanised iron belt 1/8 inch mesh, which was enclosed so as to maintain a draught of air at 25°C. After 3 hours the concentration was 60-70%. The ribbons were then cut to 1/4 inch lengths and put into drying bags. Total drying time was 24 hours. Final moisture was 10%.

122. —— Report No. B.I.O.S. 1212
GERMAN GELATIN AND HIDE GLUE INDUSTRY. pp.15 and 131 (Diagram). Automatic air control. p.30. Extrusion of gelatin noodles. 3 pp. description of dryer. p.64 - 5, Thin sheet glue. p.86 - 97. Cake glue. p.104 Flake dryer. The major effort of gelatin manufacture was for photographic purposes.

123. Sheppard, S.E., Houck, R.C., Dittmar, C. J. Phys.Chem. 44 185-194 1940
GELATIN: MOISTURE SORPTION. Sorption and desorption curves are sigmoid, and they display hysteresis like cotton. Data for various gelatins.

124. Sheppard, S. E., Ind.Eng.Chem. 28(4) 1936 422-423.
Hudson, J. H.
PRESSED FOAM GELATIN. New method of producing gelatin. Description and curves for water absorption.

125. Tolman, L. M. Food Ind. 4, 177(1932).
DRYING GELATIN INDUSTRIALLY.

126. Warburton, F. L. Proc.Physical Soc., 58, 585, 1946.
SOME THERMODYNAMIC RELATIONS OF RIGID HYGROSCOPIC GELS. In studying the absorption of liquids by rigid gels, certain thermodynamic relations are required in terms of stress components and generalised co-ordinates. These have been derived using the analytical methods of Gibbs as developed by Guggenheim, and the conditions under which they hold are clearly defined. The analysis includes a new derivation of Kirchhoff's relations for the heat of absorption, in which it is shown to be an exact relation between the isopiestic and isothermal heat of absorption and the isopiestic and isosteric variation of equilibrium humidity with temperature, where the pressures concerned are the external pressures on the gel-liquid phase. The effect of internal stresses existing in a homogeneous gel-liquid phase due to the absorption of the liquid is obtained by assuming that the energy of expansion of the gel is the same for expansion due to absorption as for expansion due to external forces. The effect of external shear stresses on vapour pressure is considered, although it is not necessary in the case of homogeneous gels, since the analysis is similar to that for the internal energy of expansion, and the effect of such stresses is required when dealing with more complex structures.

127. Weidinger, A., Pelser, H. Rec.Trav.Chim. 59 64-72 1940.
GELATIN GEL: WATER ADSORPTION MECHANISM. Investigation of Bound and Intra-micellar moisture, by inclusion of cobaltous chloride, and x-ray observations. After drying and reabsorption up to 35%, the cobalt salt remained blue shewing that the water is wholly contributing to widening of the side chain spacing. The x-ray spectrogram becomes constant at the beginning of colour change and thereafter absorbtion is inter-micellar.

Glycerol

128. Beswick, W.R., Fraser, N.C. B.I.O.S.Rept.No.335 p.85-87
GLYCEROL DISTILLATION. Preliminary Drying at 40 m.m. pressure. Moisture reduced from 10% to 3-5% @ 95°C. Entrainment separator.

129. Lamm Trans.Forod.Soc.34 1158 1938
THE DIFFUSION OF WATER IN GLYCEROL.

Gypsum

130. Arnold, M. H. M., B.P.613,207.17.1.47.
Young, R. J. & I.C.I.
DEHYDRATION OF GYPSUM. Hot gas, e.g. air, is passed through a bed of gypsum at such a rate that the particles are maintained in the fluid state.

131. Buessem, W., Cosmann, O. and Schusterius, C. Sprechsaal v 69 n 28,29,30 and 31 July 9. 1936 p.405-6, July 16 p.421-2, July 23 p.433-4 and July 30 p.443-5.
DIE ENTWAESSERUNG DES GIPSES. Dehydration of gypsum; results of experimental investigation carried out at Kaiser-Wilhelm Institute for Silicate Research.

132. Nacken, R. and Fill, K. Tonindustrie-Zeitung, vol.55, nos.73,75 and 76, Sept.10, 1931, pp.1031-1032, Sept.17, pp.1057-1059, and Sept.21, pp.1070-1071, 7 figs.
ERSCHEINUNGEN BEI DIE ENTWAESSERUNG DES GIPSES (DEHYDRATION OF GYPSUM). Results of tests in vacuum; influence of air; water as pressure bearer; it is claimed that results of tests by other investigators carried out under admission of air, partial water-vapor pressure of which had not been determined, can be considered only as approximate values.

133. McTaggart, E. F. M. Inst.of.Chem.Engrs.Lecture 11.1.1949.
Integral grinding and calcining mill at 400°C used to remove the water to the hemihydrate form.

Ink

134. Cohen, J. D. Paint Manufacture v 7 n 8 Aug 1937 p.246-50.
DRYING OF PRINTING INKS. Mechanism of drying of inks on paper; notes on normal and quick setting inks; relation between ink and paper; prevention of set off.

135. Crews, A. G. Gas, Dec.1947, Vol.23, 12, 30-1.
RAPID INK DRYING WITH GAS. Gas-drying equipment designed and installed by the Selas Co. of Philadelphia to accelerate production by Pacific Press Inc. of news and picture magazines is described. Production rates up to 18,000 64-page books per hour with a web speed of 900 ft. per minute have been attained. Gas-fuelled drying chambers are placed on the presses directly after each printing unit. The burners are of the ribbon type, designed to release up to 11,000 B.t.u.'s per lineal inch, and are set in groups of five or six

transversely across the press, so as to give about 10-in. web clearance. Flame impingement on the paper web is intended, combustion occurring directly on the wet impression. This high concentration of heat on the wet face of the web explodes the volatiles from the inks and sets them immediately. The impressions are smear-proof less than a second after leaving the plate. Special inks have been developed which show permanency under application of 2600° of temperature for short periods, and are stable at room temperature. Natural gas used as fuel for the dryers is fed into Selas carburetting mixers and the actual amount of gas mixture delivered to the dryers is determined by press drive, which gives absolute proportioning of the manifold pressure on the burners to the speed of the press.

136. Curado, J. G. — J.Oil & Colour Chem.Assn. 31 No.342 p.497 12/1948.
Sum Chem. Corp.
Resd. & Dev. Dept. N.Y.
INK. Resume of the methods and inks for rapid drying.

Insecticides

137. Alford, E. C. — Chem & Met Eng, 41, 634-6, 1934 Dec.
Spray Drying Insecticides and Allied Chemicals.

Lignin

138. Dawson, T. R. — J.Rubber Research 18 No.1.pp.1-11. Jan.1950.
LIGNIN. Molecular structure, chem. and phys., properties are discussed.

139. Freudenberg — B.I.O.S. Final Report No. 18 FD.300 4/1948
Lignin Chemistry in relation to industrial utilisation.

140. —— — F.I.A.T. Report No.444.
Dryers for Lignin and wood chips.

Lime

141. Gibradlo, F. — Rock Products 52 No.9 63-4 1949.Chem. Abstr.43 8217 10/11/49.
LIME. CALCINING W. INDIRECT - FORED ROTARY KILNS. Considerable moisture was found near the discharge end of the kiln, owing to diffusion countercurrent to the main gas flow, probably in the gas layer near the wall surface.

142. Wall, C. J. and Ash, W. J. Industr.Engng Chem., 1949, 41, 1247-1249.

FLUID-SOLIDS AIR SIZER AND DRYER. The commercial application of fluidisation to the prep. of a dry, dust-free feed of crushed limestone to rotary lime kilns is described. The feed (-4-mesh to dust) and air heated to 400^0 are fed into the unit where an automatic discharge gate maintains the depth of bed at 1 ft. The moist dust-laden air leaves 75^0 and the dry sized feed is discharged at the bottom of the bed. In addition to an economy in fuel, most of the dust is recovered as a dry, marketable products from cyclone separators.

Magnesium Salts

143. Kunkel, K. E. Chem. & Met. Engn. g. 53 254 + March 1946

SPRAY DRYING OF MAGNESIUM CHLORIDE. This method will dry the material fast enough to prevent excessive hydrolysis at an inlet air temperature of 950^0F. and a drying time of 6 seconds. Inconel was found to be the most satisfactory material for the atomisers (speed 12,000 r.p.m.).

144. Itaru, Ueno J.Soc.Chem.Ind.Japan. 47 849-50 (1944)
Chem Abstr. 43 1918. March 1949.

MANUFACTURE OF ANHYDROUS MAGNESIUM CHLORIDE FROM MAGNESIA AND AMMONIUM CHLORIDE BY CALCINING. Long abstract giving account of the reactions involved.

145. Bloem, D. L. Bull.Amer.Soc.Test.Mater., No.152, 76, 1948.

EFFECT OF DRYING TIME ON RESULTS OF MAGNESIUM SULPHATE SOUNDNESS TES
With the type of container used in these tests it was not possible to dry magnesium sulphate soundness test samples of sand to constant weight in less than about 30 hr. Samples tested at the rate of one cycle per day had losses less than one-half as great as those which were dried to constant weight after each cycle. The smaller the size of aggregate tested, the greater was the drying time required to ensure uniform results and the greater was the error introduced by using an insufficient drying period. It is not sufficient to determine the time required to dry to constant weight after the first cycle and use that drying period for subsequent cycles since drying becomes more difficult as the test progresses due to salt deposits building up on the aggregate particles and in the voids. (2 tables.).

146. —— I.G. Farben. F.I.A.T. Microfilm Reel L.F.102 Frames 249-256 U.S. Dept of Commerce. Official Techn. Service P.D.L. 65,519 Jan. 1946.
DEHYDRATION AND REFINING OF POLYMER GASOLENE.

147. Anon. Wld Petrol., 1947, 18, (11), 47.
SHELL'S ELECTRIC DEHYDRATION PLANT. Operation of Shell's Petreco emulsion treating plant (24 units) at Lagunillas, Venezuela, is described. An A.C. (60 c.p.s.) field of 33,000 V., reduces the water content of crude oil (maintained at ca. 165°F.) from 35% to 2%. Plant capacity is 6000 m^3 oil/day.

148. Anon. Nat. Petrol. News Tech. Sec. 3 Jan, 1945 37, (1), R.63; J. Inst. Petrol. 1945, 31, 340A.
DEHYDRATION OF FURNACE OIL WITH ACTIVATED ALUMINA. Activated alumina is exceptionally useful as a dehydrating material, as it is easily regenerated and has high absorptive qualities. The drying system described is composed of two vertical tanks 6 x 2½ ft. connected in parallel, one for use, while the other is under the process of regeneration. Each holds 550 lb. of 4-8 mesh activated alumina, which is sufficient to dry 100,000 gal. of furnace oil, on the basis that this amount is saturated with moisture at 75°F. The rate of flow is normally 750 gal./min. The alumina will absorb 7.4% moisture, by weight, before moisture begins to pass on with the flow. Regenerating methods are discussed - e.g., the use of hot flue gases or inert gases, methane, or nitrogen - but the method favoured is by heating the charge under a relatively high vacuum, using the available 90 p.s.i. steam for this purpose, through a 200-ft. 1-in. coil situated in the vertical tanks described. The coil is surrounded by the alumina, the heating area being equivalent to 1 sq. ft. per 8 lb. of alumina. Nearly bone-dry furnace oil is obtained. Moisture control is made by the liberation of acetic acid, by the reaction of water in the sample from acetyl chloride in the presence of pyridine, and its titration with standard alkali.

149. Briggs Clarifier Co. B.P. 590,214/1947.
APPARATUS FOR DEHYDRATING LUBRICATING OIL.

150. Briggs, S. W. U.S.P. 2,393,965 5.2.46.
Briggs Clarifier Co.
DEHYDRATION OF OIL. Use of Steam heated tubes containing rather tightly fitting wire ropes, fastened by header plates.

151. Gester, C. C. Chem. Engng Progress, Trans., Mar. 1947, 43, 117-122.

DESIGN AND OPERATION OF A LIGHT HYDROCARBON DISTILLATION DRIER. This paper describes the design and actual plant operation of equipment which reduces the water content of a hexane cut from 130 to less than 20 p.p.m. A brief resumé is presented describing other equipment considered, and in one case actually tried, for the purpose of dehydrating dewaxing plant hexane. The prediction of vapour-liquid equilibrium data is described and a simplified flow diagram illustrates the column and its appurtenances. Plant data from this unit, which is capable of drying more than 65,000 lb./hr of hexane substantiate the design bases and allow prediction of performance characteristics for future similar designs.

151a. Korbova, B., Charvat, V., Simek, B. Erdol u Kohle 4. 28-30. Jan 1951

DETERMINATION OF MOISTURE CONTENT IN REFRIGERATING OILS. An acc. of the proposed new German specifications.

152. Martin, R. G., Thompson, C. N., Shell Ref. and M. Co. Br. J. Appl. Physics 2 8. 222-226. Aug. 51

A VACUUM PRETREATMENT APPARATUS FOR FILTERING, DEHYDRATING AND DEGASSING OIL. A laboratory apparatus has been tested for efficiency for above purposes. 1% H_2O can be removed in one or two treatments. Quotes the E.R.A. work on the effect of cotton fibres in decreasing the dielectric strength, especially in presence of water.

153. Phipps, H. K. Oil Gas J., 23 Nov. 1946, 45, (29), 67.

USE OF DEHYDRATION IN COMBATING INTERNAL CORROSION IN PRODUCTS PIPELINES. Interior corrosion in pipelines is due chiefly to the presence of water in the product being transported, which separates, and, in combination with free oxygen in solution in the product, causes rusting. The dehydration process lowers the moisture content of the product to a small amount such as will remain in solution even when minimum line temperatures are met. Scrapers are not necessary with dehydration. The installation at Augusta, Kans. pump station consists of six drums 4 ft. in diameter and 9 ft. high, with cone bottoms. 3000 lb. of 4-8 mesh activated alumina supported on a metal perforated plate is used as dehydrating agent. The product is pumped through 3 of the towers in parallel, towers being regenerated by passing superheated steam at 450°F. through the bed until it has reached 380°F., then blown with refining gas, evacuated and then filled with natural gas. Regeneration takes place every 12 hours or on change of product, and requires about 5 hours. Throughput is 700 brl. per hr., about 60% of the total water being removed. Costs will not exceed 50 cents per 1000 brl. of throughput, and actual costs for the installation described were 41 cents per 1000 brl. and complete prevention of interior corrosion is claimed.

154. Sharapov, Y. N. Stal, 1947, 7, 170; Chem. Abstr., 1947, 41, 6391.
DEWATERING MAZUT. To dewater mazut used for firing open-hearth furnaces add to it 0.3% of NaCl, mix thoroughly (e.g. by passing steam) for 15-20 min., heat to 100-5^0 and hold at this temperature for 2-3 hours, drop the temperature to 85-90^0, and hold at this temperature for approximately 10 hours during which the oil and the H_2O separate. Drain off the H_2O.

155. Singer, L. Petroleum. (Berlin) v. 26, p. 692-695 June 18, 1930.
RECOMMENDATIONS FOR PRETREATMENT AND DEHYDRATION OF OILS. (Vorschlage Vorbehandlung und Entwasserung von Oelen).

156. Salathial, R. A. U. S. 2, 443, 273. 15.1.46 Chem. Abstr. v 42. 6100. 1948.
Standard Oil Co.
WATER IN OIL EMULSIONS. Break by Amine salt of a petroleum derived sulphonate.

Paint

157. —— C. I. O. S. Report 34-18 F. I. A. T. 681.
DRIERS FOR PAINT (PRODUCTION).

158. Anon. Industr. Heat., Sept. 1948, vol. 15, 1557-1558, 1560, 1562, 1564.
GAS CONVECTION HEATING CURES AUTOMOTIVE FINISHES AT BRIGGS MANUFACTURING CO: II. A discussion of the burner equipment and controls employed in the drying ovens is given.

159. Anon. Ind. Heating Engr. 10(44) 193-4 Nov 1948.
PAINT SPRAYING AND DRYING IN THE MOTOR INDUSTRY. Description, some data, three illustrations.

160. Anon. Electricité, Mar. 1947, 31, 51-52.
INFRA-RED DRYING OF PAINTS AND VARNISHES. Photographic illustrations are given of four installations for infra-red drying of paints and varnishes on the continuous system. A table provides the principal characteristics in parallel columns. E. R. A.

161 Adams. Ind. Finishing 23(5) p. 32-4-6-8 1947.
Time-Temperature Relations. Importance of type of paint used

162. Austin Motor Company, Ltd. Brit. Pat., 580, 667, 16/9/46.
and Waldron, C.
CONTINUOUS OVENS. The invention relates to continuous ovens used for drying paint or other pigment on motor vehicle bodies while they are being passed continuously through the oven, but it is applicable also to the drying of other materials.

163. Bryson, H. C. Paint Manufacture v 7 n 6 June 1937 p 185–7.

MEASUREMENT OF DRYING TIME. Account of different methods employed in this measurement, together with experimental results.

164. Cederlund, K. E. Färg och Fernissa 11 114–118 1947 BII. 623. Dec 1948.

INFRA-RED OVEN FOR PAINTS. Drying of paints and lacquers by I.R. is discussed. Data quoted for 0.6 to 24 microns shew that even for infra-red reflecting pigments (Cr_2O_3 Fe_2O_3, $PbCrO_4$ and Zn O) the reflectance falls to a low value at 4.4 microns.

165. Clauser, H. R. Pap. to Amer. Gas Ass. Conf. on Industr. and Commercial Gas, Apr. 1948; Industr. Gas, June 1948, vol. 26, (12), 12–14, 22–29.

INDUSTRIAL PAINT DRYING: METHODS AND EQUIPMENT FOR DRYING ORGANIC FINISHES. The principles of operation, the characteristics, capabilities and limitations of various methods and equipment commonly used for drying industrial organic finishes by radiant and convection heating are discussed.

166 Dickinson, F. Gas Jnl. 257 4471. 308. 9 Feb 1949.

COMMERCIAL AND INDUSTRIAL UTILISATION OF GAS. Paint and lacquer drying. General description.

167. Ernst, R. C. Ind. Eng. Chem. 36 1132–7. 12/1944.
Schumacher, F.

RADIANT HEAT BAKING OF ENAMELS.

168. Fairburn, R. J. Ind. Finishing 21 1945 No. 5. 76–8. 80–2–4.
Geschwind, J. F. No. 11. 46–8. 50–2–6–8. 60.

Controversy re convection and infra-red heating. Concensus of opinion: A combination of the two is probably the best solution.

169. Fitzsimmons, W. A. Paper to Yorkshire Junior Gas Ass; Gas Wld, Indust. Gas Suppl. 21 Apr. 1945, 18, 39–42; Woodall Duckham Abstr.

TEST DATA ON A MULTITUBULAR TYPE GAS-FIRED INFRA-RED OVEN. A description is given of a continuous infra-red oven used for experimental work on the drying of metal finishes with details of its performance and of results so far obtained. In their passage from the hot to the cold end, several enamels were dried satisfactorily in 45 sec. to 5 min. depending on their type.

170. Friedman, L., Chandler, D. B.P. 620, 239 10.1.47

DRYING OVENS OR STOVES. Oven having triangular cross-section, gas heated panels mounted on each side of the roof. Articles carried on a belt parallel to the oven floor. Hot flue gases are sucked through the chamber.

171. Gay, P. J. Br.Paint.C.& V.Mfrs.Res.Asscn.Tech.Paper 162. Confidential.
Absorption of liquid water by paint films on solid substrates
D.S.I.R/2671/b.

172. Gschwind, J. F. Elect.Wld,26 Apr.1947,127,56-57.
MORE OUTPUT-LESS SPACE WITH INFRA-RED OVEN. An illustrated description of two fully enclosed and insulated paint drying ovens in which 1,152 reflector lamps are used to provide the heat. These ovens were specially designed to save space. E.R.A.

173. Henley, A. T. Trans.Inst.Chem.Engrs.6 pp.102-114. Conf.6.12.28.
TUNNEL AND STOVE DRYING. Application to painted, lacquered and enamelled surfaces. Including vertical ovens.

174. Jung, F. P. Heat.Vent.,May 1946,43, No.5,62-4.
RECIRCULATING SPRAY BOOTH EXHAUST. The author developed a mathematical method of showing maximum spray booth concentrations that will develop when various proportions of exhaust air are recirculated. The possibilities of spray booth economy with exhaust recirculation are pointed out.

175. Krupp, P. H. Industr.Finishing.26(4).20.23.4 Feb.1950.
INFRA-RED DEGREASING AND PAINT BAKING. Process and satisfactory results are described.

176. Lewis, W. K., Squires, L., Saunders, C. E. Ind.Eng.Chem.27 12 1395-6 Dec.1935.
EVAPORATION OF LACQUER SOLVENTS.

177. Mackadam, A. C. F. Canadian Gas J.Feb.1945,38,33-35;Woodall Duckham Abstr.
INFRA-RED DRYING BY GAS. Described the application of gas to the infra-red drying of paint and gives suitable intensities of radiation.

178. Rieger, G. and Grove, C. S. Ind.Eng.Chem.Anal.Ed.,1942,14,326-333.
THIN FILMS: DETERMINATION OF DRYING RATES. The article describes apparatus used to study nitrocellulose films (maximum weight 0.02 g; area 13 cm^2; solvent content 300 mg.; drying time 20 minutes) and reproduces in graphical form the results obtained. The results, which are shown to be reproducible, indicate that the drying rate of a nitrocellulose solution is a function of the type (viscosity) of nitrocellulose in solution. A Christian Becker (Type 508-A) air-damped analytical balance was used with the objective lens so adjusted that the scale was projected on to a screen.

The films, which contained Sudan I to enable area measurements to be made, were cast on microscope slides, the film caster used being a 5 cm. length of 3.1 cm. thick walled bradd tubing.

179. Silman, H. Found. Tr. J., 8-15 Mar. 1945, 75, 195-198, 217-221.
SCOPE AND LIMITATIONS OF RADIANT HEATING IN DRYING PROCESSES. Descriptions are given of equipment for the rapid drying of paints and enamels by banks of electric lamps emitting infra-red rays and by incandescent gas-burners. Curves show the difference in the time required to heat up metal plates coated in different colours. The economics of the process are discussed.

180. Thomas, A. M. J. Appl. Chem. 1 141-158 April 1951.
MOISTURE PERMEABILITY, DIFFUSION AND ABSORPTION IN ORGANIC FILM FORMING MATERIALS. Analysis by appln. of thermodyn. and adsorption theories of exptl. work by Br. El. Res. Assn.

181. Thomas, A. M., Gent, W. L. G. Proc. Phys. Soc. 1945, 57, 324-349.
VARNISH FILMS: PERMEATION AND SORPTION OF WATER VAPOUR. Experimental methods have been developed for determining the sorption of moisture before equilibrium is reached and the movement of sorption at equilibrium (permeation) of varnishes and polystyrene as free films. The preparation of test materials and the experimental procedures are described and the results are tabulated and discussed. There is reason to believe that the mechanism of permeation is one of osmotic diffusion. Not sufficient evidence was found to show the effect of temperature and vapour pressure on the permeability constant. The factors determining the absolute diffusion rate and sorptive capacity depend on the structure of the material.

182. Wolff, H. Farben-Zeitung, vol. 36, no. 51, Sept. 19, 1931, pp. 2200-2201.
VERGLEICHENDE UNTERSUCHUNG VON TROCKENSTOFFEN (COMPARATIVE INVESTIGATIONS OF PAINT DRIERS). Previously indexed from Fachausschuss fuer Anstrichtechnik, no. 12, 1931.

183. Zimmer, F. Farben-Ztg. 36, 918-9 (1931) Feb. 14.
DRYING APPARATUS FOR NITROCELLULOSE LACQUER. Dryers used in connection with continuous lacquering process for dryers and lacquering small and large mass products.

184. ---- Chem.Eng.Progress.p.111.Oct.1949.
CHLOROMYCETIN. The crystals are vacuum dried on trays to remove residual Amyl acetate.

185. Anon. Chem.Products.13(5)p.197 Apr.1950.
STREPTOMYCIN PRODUCTION. Glaxo Developments and Research. The calcium chloride salt is seitz-filtered and freeze dried in bulk.

186. Addinall, Dr. C. R. C.T.J.Vol 126.No.3277 p.709.
of Merck, Rahway, N.J. 24 March 1950.
STREPTOMYCIN. PRODUCTION OF. The streptomycin concentrate is concentrated to small volume at low temp. under vacuum, and the S. is isolated as a solid. The latter is taken up in alcohol, and a calcium chloride complex is crystallised from the solution. Filtered, washed and dried and alcohol recovered. No details. The Ca Cl_2 complex is purified by "certain procedures" to remove traces of heavy metals, and the purified material is finally obtained as a dry sterile powder.

187. References.
PENICILLIN.
Sci.Amer.170.9.1944 - Anon
Science 99 285-6 1944 - Campbell & Pressman
Br.Med.Jnl 1945.1.216-8 1945 - Flosdorf
Nature 153 3886.485-7.1944. - Greaves, R. I. N.
Ind.Chem.20 229,54.1944 - Reavell, J. A.

188. Anon. Radio Corp.of America News Release 30.7.1945.
PENICILLIN. It is claimed that H.F. heating reduces time by more than 50%.

189. ---- Ind.Heat.Eng.1/1949 11.45 p.12.
Description of Distillers Co. new plant at Speke. Illustr. Vacuum drying at 6 microns, Chlorinated hydrocarbons in diffusion pumps.

190. ---- Chem.Inds.7.1948.63 1.30.
Penicillin is spray dried in Sweden. Kaernbolaget using NIRO spray dryer to form powder. This is only used orally. A product sufficiently sterile is expected to follow.

191. ---- Chem.Inds.63 page 402 Sept.1948.
Production in Sweden and Denmark of dry Penicillin by Spray Drying.

192. Brown, G. H., Bierwirth, R.A. and Hoyler, C. N. Proc.I.R.E., Feb. 1946, 34, 58W-65W.
RADIO-FREQUENCY DEHYDRATION OF PENICILLIN SOLUTION. This paper describes experiments and developments made by the authors to bring about the drying of penicillin by the application of radio-frequency power in a very moderate vacuum. The method may ultimately be applied to drying other pharmaceuticals. E.R.A.

193. Carr, C. and Riddick, J. A. Ind.Eng.Chem. 12.8.1947 39 8. 1021-3.
HYGROSCOPICITY OF PENICILLIN SALTS. Sodium, calcium, potassium, ammonium salts. Curves. Critical humidity points.

194. Flosdorf, E. W.
PENICILLIN. See under "Freeze Drying".

195. Heyden Chem. Corp. (J. Simon) B.P.625,924.14.11.1946.B.II.Col.33. Jan.1950.
PRODUCTION OF PENICILLIN. A long abstract giving details of production and referring to spray drying from a whirling disc atomiser into a drying gas, e.g. air, N_2, CO_2, or combustion gases at 150-500°F. arriving at a powder with less than 5% M. after which it can be vacuum dried. A product with 3.6% M. and 729 Oxford units per m.g. did not change on storage for 3 months at room temp. in sealed vials.

196. McKeon, J. E. Trans.Amer.Inst.Chem.Engrs.40, p.754-5 & 771 1944.
DRYING OF SODIUM PENICILLIN SOLUTION. Air conditioned sterile chamber at 10% R.H. Vacuum Freeze tray dryers at 100 microns. Final moisture content 1%. Illust.

197. Merck & Co. B.P. 622,305. 1947. B. II-33. Jan. 1950..
DRYING OF PENICILLIN. Water is removed from a solution of the P-salt by distillation with, say, dichlor-ethane, light petroleum, or chlor benzene, and recover the P-salt from the solvent residue, in which it is of course insoluble.

198. Morse, R. S. Ind.Eng.Chem. 39 1064. 1947.
Deals with cabinet drying of penicillin, streptomycin, plasma.

199. Singer, J.H., Glaxo Labs. Proc.Inst.Refrig. 43 167-75 176-82, 1946-7.
THE APPLICATION OF FREEZE DRYING TO PENICILLIN PRODUCTION. A good review of the penicillin process and history of manufacture. Adequate data are given for an understanding of the principles involved.

200. Stephens, R. L. Inst. of Chem.Engrs. 11/1/1949. Paper. p. 20.
H.F. drying of penicillin in spinning ampoules between electrodes. Drying is rapid and leaves a skin of penicillin on side. No deterioration.

Phosphates

201. Atwell, J. Ind.Eng.Chem.41(7) p.1323.1949.
PHOSPHATE PROCESSES AT TRAIL B.C. Crystals too small for use are coated with slurry and dried in a concurrent rotary dryer with outlet temp. 100°C. 50 tons of water removed per day. Output 3000 tons per day (for fertiliser). Dust recovery.

202. Bell, R. N. Ind.Eng.Chem.39 136 1947.
HYDROLYSIS OF MOLECULARLY DEHYDRATED PHOSPHATES.

Photographic Materials

203. —— B.I.O.S. Report 252.
DRYERS FOR PHOTOGRAPHIC PAPER AND FILM.

204. Soker, A. K. Inst.of Fuel "Drying Study" March, 1951.
DRYING IN THE PHOTOGRAPHIC INDUSTRY. Special provision for protection from light, chemical and electrical action and for ensuring uniformity in drying rate. General account of the process and of future trends. Infra-red and high frequency applications are not attractive. Progress likely to lie, in more efficient use of hot air dryers.

205. White, D. R. Soc.Motion Picture Engrs - J. v 19 n 4 Oct 1932 p.340-5.(discussion)345.
DRYING CONDITIONS AND PHOTOGRAPHIC DENSITY. Sensitometric study of effect of varied drying conditions on positive film; it is found that gamma changes considerably with drying conditions; at 86 F, for instance, increase from 36 to 80% in relative humidity increased gamma from 1.97 to 2.45; effect appears to be concurrent with softening of gelatin during drying.

Pigments

206. Anon. Industr.Chemist 26 (306) page 308 July 1950.
A NEW ORGANIC PIGMENT FACTORY. A description of the new Hawkshead factory of James Anderson & Co. (Colours) Ltd. A short para. on drying states that the material from the filter presses is carefully spread on trays, the latter stacked in supporting frames and the latter placed in ovens which are thermostatically controlled between 115°F and 180°F according to the pigment. The air is heated by gilled steam coils. Illustration shews 6 very large ovens (presumably operating at various temperatures).

207. Arend, A. G. Paint Techn. 1946. 11 122. 47-9.
PIGMENT DRYING. Continuous Vacuum Drying of pigments in 2 stages, a rapid drying on a vacuum drum dryer, the partly dried material being then passed automatically into a horizontal cylindrical vacuum dryer containing hollow rotating paddles, and out into receiving bins. The paddle equipment is easily removed for cleaning while a new batch of pigment is being precipitated.

208. Bolt, H. R. et al B.I.O.S. Report No. 1402.
MANUFACTURE OF INORGANIC PIGMENTS IN GERMANY. P.7 Ultramarine:- Compartment dryers at 130°C takes 4 days. P. 19 Tunnel Dryers. Diagram of large bank of tunnels. P. 57 Prussian Blue - Drying Trays - put by hand, in tunnels .45°-50°C. Other pigments dried by similar simple processes.

209. Clegg, L., Jackson, S. V. Inst. of Fuel. "Drying Study" March '51.
LITHOPONE. The Drying of Pastes, Powders and Crystals
1. Drying lithopone in a concrete tunnel, with countercurrent flow and recirculation.
2. Drying in a steam heated vacuum shelf dryer. Heat balances are given.

210. Clegg, L., Jackson, S. V. Inst. of Fuel. "Drying Study" March '51.
WHITE LEAD. The Drying of Pastes, Powders and Crystals. After vacuum filtration the paste, containing 35% water, is passed to a Simon Rotary Tubular Dryer by way of a preheater and pug screw. The moisture is drawn off by an ejector condenser system. A heat balance is given.

211. Commonwealth Eng. Co., Chem. Inds. p. 501. Oct. 1949.
Dayton, Ohio.
CHEMICAL PROCESS REPLACES PIGMENT GRINDING. The pigments are incorporated with oils and resins into a paste while water is simultaneously removed, with stirring and controlled heating. Batch grinding might be replaced by this means.

212. Kastens. Hansen
DRIER SOAP MANUFACTURE. See under "Soap".

Plastics

213. Anon. C.T.J. 17 Feb. 1950. 126. 3272. 409-10.
AMINOPLASTICS MANUFACTURE. Urea or melamine formaldehyde resin is spray dried. Spray disc revolves at 13,000 r.p.m., furnace gases are used to dry the spray. Outlet temp. of resin is 95°F.

214. Anon. Internat. Chem. Eng.g. 30(11)518. Nov. 1949
ROTARY DRYER AND PREHEATER. Brief reference. Plant consists of revolving drum with 12 compartments which revolve round a special electrical element. Length 3 ft. 7 inches but travel is equivalent to a conveyor 15 ft. long. Units deal with up to 400 lb. per hour.

215. —— B.I.O.S. Report No. 433
A Buttner Dryer for Plastics is described.

216. —— B.I.O.S. Report No. 999
SPRAY DRYING OF P.V.C. EMULSIONS.

217. Alexander, W. E. F.I.A.T. Final Rept. 859 pp. 18 & 19
ACETYLENE MNFR. VINYL ACETATE AND VINYL CHLORIDE MONOMERS. Methods of purification and drying are described and detailed diagrams are given.

218. Ball, J. M. et al B.I.O.S. Misc. Rept. No. 1 p. 32
THE GERMAN PLASTICS INDUSTRY. The centrifuged powder, containing 35% moisture is blown to storage bins, and thence to a 40 tray Buttner turbo dryer. Hot air at 80°-100°C is passed through and the matl. takes 1½ to 3 hours to dry. Output 200-300 tons per month.

219. Deeg G. Jr., Frosch, C. J. A.S.T.M. Symposium or Plastics 47-53. 1944
PLASTICS. MOISTURE PERMEABILITY. A method for measuring diffusion in plastics is described. Diffusion data for a number of plastics is tabulated and correlated to show how diffusion is affected by comportion plasticiser, degree of acetylation, fillers. The effect of water sorption on the diffusion constant is discussed.

220. Hailwood, A. J., Horrobin, S. Trans. Faraday Soc., 1946, 42B, 84-92
POLYMERS: ABSORPTION OF WATER. The absorption of water by polymers is analysed in terms of a simple model which postulates that the process is governed by (i) the formation of a solid solution of water in the polymer, and (ii) the formation of hydrates between water and definite units of the polymer molecule. It is further assumed that the mixture of polymer, polymer hydrates, and dissolved water forms a single and solid phase. The assumption of ideality in the solid phase allows the absorption isotherm and also the equation and connecting volume and amount of adsorbed water to be explicitly derived and tested by comparison with experimental data on wool, hair, silk, nylon, and cotton. Satisfactory fits are obtained. The most serious deficiency of the model is its failure to provide for the hysteresis displayed by fibres, except nylon. , It is submitted, however, that the model merits consideration as the basis for further experimental and theoretical studies.

221. Hauser, P. M., Ind.Eng.Chem., 1948, 40, 112-117
McLaren, A. D.
HIGH POLYMERS: PERMEATION THROUGH AND SORPTION OF WATER VAPOUR. Recent studies of water vapour transmission by high polymers (see P. M. Doty, Summary, 1945, p. 113) have indicated that the permeability constant P can be broken down into two factors, the diffusion constant D, and the solubility coefficient S; i.e. P = DS. In that work, P and D were measured and S computed. In the present study P and S were determined for a variety of polymers, including nylon, regenerated cellulose, and vinyl polymers such as polyethylene and vinylidene chloride/acrylonitrile co-polymer. Permeability was determined by a cup method and the values of the solubility coefficient were obtained from the water vapour sorption isotherms in the air. The results showed that Henry's law is not obeyed except for the vinyl polymers below 50 per cent. relative humidity and that P is usually not a constant as the vapour pressure changes. These findings make the expression P = DS useful for describing the behaviour of the vinyl polymers only, and only at low relative humidity.

222. Hayman, R. F. Fuel. & the Future. 1. p. 259
Removing volatiles from P.V.C. sheet at 600-650^{0}C. in a minute or two by infra-red heating.

223. Hermann Rubber Age 36 73. 1934.
DIFFUSION OF WATER THROUGH ORGANIC INSULATING MATERIALS.

224. Kovacs, A. J.Chim.Phys., 1948, 45, 258-269.
(In French)
PLASTIC MATERIALS: DIFFUSION AND ABSORPTION OF WATER. A simple method, based on Fick's law, for the determination of the diffusion coefficient has been developed and its application to the study of water absorption by a number of commercial plastic materials is considered. This method permits the utilisation of plates of finite thickness, whereas most other methods can only be applied to very thin films. The variation of the diffusion coefficient during absorption as a function of mean concentration is illustrated for Plexiglas, celluloid, and cellulose acetate. Data on the variation of the mass of the samples during absorption and desorption and on the variation of the modulus of elasticity as a function of absorption are also given. The results show that for a certain class of plastic materials Fick's law does not apply.

225. Yarsley, V. E. Plastics Applied 1946. Nat. Trade Press Ltd. page 248.
Moulding powder being dried in a tray in 10 minutes by infra-red heating.

226. Young, K. W. C.I.O.S. Report. No. 33-31 pp. 63-4
INVESTIGATION OF CERTAIN CHEMICAL FACTORIES. P.V.C. latex from the autoclaves is spray dried (diagram). 36 jets on circumference. Some details of operation, capacity, etc. pp.53. Wet filter cake dried on an Imperial dryer. Trays on continuous band in horizontal drying chamber 80°C to 60°C. (Few details).

Potassium Chlorate

227. Bloore, E.J., Kent, F.G., B.I.O.S. Report 1539.
Svance, E.O.
POTASSIUM CHLORATE.
p. 13. Stainless Steel liner. Rotary dryer made by Beno Schilde of Hamburg. Hot air, 180°C, exit temperature 100-115°C.
p. 18. Passburg type steam jacketted vacuum dryer.

Rubber

228. Pinkney, P. E., Br. Rubber Manufacturers Research
Dawson, T. R. Association. 1949.
BIBLIOGRAPHY. A well classified compilation of about 350 literature and patent references. D.S.I.R. library.
1. Drying of Latex.
2. Drying of Crude Rubber.
3. Drying Machinery..
4. General Methods of Drying Textile Fabrics.
5. Drying of Compounding Ingredients.

The above main headings are each classified.

229. Anon. Engineering v 141 n 3655 Jan 31 1936 p. 134-5
DRYING MACHINE FOR LATEX-TREATED FABRIC.

230. —— B.P. 534, 186 (February, 28th, 1941). Brit, chem. physiol. Abstr. B. I. 1941, p. 202
IMPROVED PROCESS FOR CONCENTRATING AQUEOUS DISPERSIONS. ALGEMEENE VEREENIGING VAN RUBBERPLANTERS TER OOSTKUST VAN SUMATRA. Substances such as cow's milk (or rubber latex) are brought in contact with the dry parts of plants (e.g. killed soya-bean seeds which have had their skins treated (broken) to improve absorption). Flour may only be used once, but whole seeds may be rinsed, dried and used again.

231. Anon.
LATEX. Large drying plant, supplied to Dunlop Rubber Co. by Spooner Dryer and Engineering Co., incorporates special methods of drying developed by makers and will dry light fabrics treated with latex at speed of 40 yd. per min. and heavier fabrics of 10 times weight, at speed of 4 yd. per min.

232. —— Heat. and Vent. Engr. 21 No. 248 Feb. 1948 page 343
Air drying takes 1 to 3 weeks for sheet rubber. Illustration of Metro Vic-Dunlop infra-red plant for continuous drying, 624 lamps, length 75 feet, 190 K.W., 115 volts, 40 foot pass, 3 passes, 4.5 fee per minute of travel = 27 minutes complete travel. 10-12% original moisture is reduced to 1.2% to 2.4%. A table of results is given.

233. Bächle, O. Kautschuk u. Gummi 2 337-43 1949
DRYING SPEEDS OF LATEX FILMS. With increase of thickness of films, the drying times increase rapidly but the drying temperature cannot be increased at will because of bubble formation. Investigation of influence of drying factors - temperature, thickness, humidity, air flow, composition, and drying on one or both sides. Equilibrium moisture is investigated. Conclusions:- Temperature should not exceed 110°C. Drying occurs in 2 phases. Speed increases with temperature. Drying slower in presence of moisture. Filler has decided effect.

234. Bixby, W. F. Chem. Eng. Progress. 45(1) p. 81-86 Jan. 1949
POROUS SHEET PROCESS OF DRYING G.R.S. AMERICAN RUBBER. Describes the continuous drying of sheet by high velosity air blast. The process employs a Foudrinier sheet machine. Data is given on drying time v.s. sheet weight and v.s. air velocity Operating conditions ar described.

235. Connell Trans. Inst. Rubber Ind. 21 285-297. 1946
APPLICATION OF INFRA-RED TO RUBBER PROCESSING.

236. Cooper, Daynes, Scott.
ABSORPTION AND DIFFUSION OF MOISTURE IN RUBBER, PARTS 1 to 4. Jnl. of the Res. Assn. of the Br. Rubber Mnfrs. 5. 131. 1936 and 6. 139. 1937. Jnl. of Rubber Research 6. 133. 1937 and 8. 67. 1939.

237. Daynes, H. A., B.R.M.R.A. India Rubber J. 84. 376. 1932.
THE MEASUREMENT OF WATER ABSORPTION BY RUBBER. Types of measuremen and views on the mechanism of absorption are reviewed. A new technique is described. This depends on the weighing of the comminuted sample in the controlled atmosphere employed during the test.

238. Daynes, H. A., B.R.M.R.A. Trans. Farad. Soc. 33 531. 1937
ABSORPTION AND DIFFUSION OF WATER IN RUBBER. A new differential equation is put forward to represent the movements of water through rubber in accordance with the osmotic theory of absorption. Consequences of practical importance arising from the work are discussed.

239. Daynes, H. A., Proc.Rubber.Tech.Conf.886.1938
Br. Rubber Mnfrs. R.A.

SOME PRACTICAL ASPECTS OF THE THEORY OF DIFFUSION OF WATER IN RUBBER. Examples are given of the importance of passage of water through rubber. Time relations in absorption and desorption are discussed under various aspects and a new theory of diffusion is put forward. Applications of the theory are discussed.

239a. Fry Br.Rubber Manfrs.R.A.Res.Rept.No.3. Nov.1921.India R.J.73 513.1927
CONSIDERATIONS RELATING TO THE DRYING OF RUBBER. Dependence of rate of drying upon temperature and properties of the rubber.

240. Goodyear Tyre & Rubber Co. Ltd., Wolverhampton Chem.Age.60 No.1555.30 Apr.1949 p.619.
RUBBER HYDROCHLORIDE FILM. Commercial Manufacture. Drying (to remove residual solvent). 250 ft. of the film is in the dryer at 200°F for 6 minutes, 22,500 ft. per min. of heated air, with alternative steam ejectors if the fan fails (to avoid fire risk by lack of excess air). In case of fire, 500 lb. of CO_2 is automatically distributed throughout the dryer.

241. Lyons Ind.Rubber World 1947 116 199-204-7
DIFFUSION OF MOISTURE TO THE CORD IN TYRES

242. Palmer, Miller & Bros. I.E.C.23, 821,1931
DRYING RUBBER. Effect of drying temp on quality of reclaimed rubber.

243. Partridge, E. G., India Rubber World 119 No.3.341-344.
Hansen, M. E. 12/1948
DRYING OF LATEX RUBBER DEPOSITS. Descriptive article dealing with air conditions. Two stages of drying (a) coagulation (b) drying. Oven conditions, air velocity, sources of heat.

244. Partridge, E. G., R.A.,NY.63 474.1948 I.R.W. 118 539 1948
Hansen, M. E. J.R.Res.17 9.670.7/48
DRYING OF LATEX DEPOSITS. Important unit process. Decrease in porosity on drying. Migration of moisture within the deposit. Films can even become wetter on entering drying oven.

245. Rossman, Joseph India Rubber World 88,No.6,31-3(1933)
DRYING LATEX. Thirty-one patents are reviewed.

246. Yarsley, V. E. Plastics Applied 1946. Nat.Trade Press Ltd.p.280.
Drying and Curing rubber coating on canvas sheet by a bank of Infrared lamps. 14 ft. high, 4 feet wide 28 K.W. 112 lamps. Diagram.

247. Youker, M. A. Chem.Eng.Progr.43 391-8.1947
CONTINUOUS ISOLATION OF GR-M. FROM LATEX. GR-M. is a synthetic rubber of neoprene type (chloroprene plus 2 - chloro - 1.3. butadiene). A Proctor and Schwartz multi-pass air lay dryer is employed with endless conveyer, the rolls being in vertical arrangement. Drying cycle is 6 to 8 mins. @ 120°C. Details of drying operation are given.

Salt

248. Badger, W. L., Inorganic Chem. Tech. 1941 (Chem.Eng.
Baker, E. M. Series) pp.29-31 McGraw Hill Book Co.
DRYING AND SCREENING. Flash crystallisation (Alberger Process) from solution. Formerly dried by standing on the warehouse floor. At present, usually dried in a rotary dryer 7-8 ft. diam., 30 ft. long, wood or monel metal lined with angles (fins) to lift the salt. Screw feed at discharge end to screening and packing. Hot air blown through the dryer. Air heated by steam coils. No data.

249. Irvin, D. F. Ind.Eng.Chem.1938 30.9.1002-3.
SALT, FILTER DRYING. Description of process and performance data for granular solids (salt) on drum and band dryers. Diagrams.

250. Lagrange, B. Chimie et Industrie (Paris), vol. 24,
no. 4, Oct. 1930, pp.805-808, 4 figs.
DRYING OF SALT. XLE PROBLEME DU SECHAGE DU SEL. Special difficulties in drying salt; different equipment proposed; centrifugation of salt.

251. Paltzer, G., Basle Swiss Electro-Tech.Asscn.Bulletin No.16.
Peter, R., Zurich 1943.
HEAT PUMP METALLATION OF THE UNITED SWISS RHINE SALT WORKS. Comparison of processes of salt drying, and application of the heat pump principle.

Sand

252. SAND. See also under Foundry Cores.

253. Mines Equipment Co. Rly Age, 3 July 1948, vol. 125, 8.
SAND DRYING UNIT. A description of a unit for drying locomotive sand. It is driven by an electric motor and utilizes for drying, the heat of an open flame produced by the combustion of either oil or gas.

254. A. Bathgate & Sons Ltd. B.P.559,928 10/3/1944
DRYING GRANULAR MATERIAL. SAND. Equipment is described for drying foundry sand.

255. ——— Coal Age 51 11.11/1946 p.92-4.

SAND DRYING. (Ore tailings for use by engines in coal mines). Rotary dried. A few shovelsful of anthracite dry 10 to 12 tons of sand in 7 hours and leave the fire banked overnight. Illustrations.

256. Seddon, E. Institute of Fuel Paper given 3 Jan 1951 C.T.J.128 84-5.12 Jan.1951

DRYING OF SANDS FOR GLASSMAKING. A description of the various methods of drying sands and equipment. Thermal balances and costs are given. Future trends are indicated, but no early alternative is yet seen to thermal treatment.

SEAWEED

257. ——— Scottish Seaweed R.A.Annual Report 1947

Includes a survey of sources, report of the chemistry and engineering divisions, and a brief account of the processing, including air drying.

258. ——— U.S.P.2,350,709/30.5/1944.Chem.Abstr. 1945/1334.

Chopped seaweed dried in rotary and conveyor dryers.

259. Bonniksen, C. W. Meeting.S.C.1.13.Feb.1951 C.T.J. 128 441-2.23 Feb.1951

THE MANUFACTURE OF ALGINATES. The paper includes reasons for drying alginates. Mainly on a/c of very rapid deterioration if allowed to remain wet (2-4 days), and for practicability of transport to processing factories.

260. Cady, W. H. Br.Chemical Digest 3(2) pp.48-50.Nov. 1948 from American Dyestuffs Reporter 37(9) 3.5.1948.

TEXTILES FROM SEAWEED. 35 Refs. Description of production and uses.

261. McInnes, Alex Press Report

Formation of a £40,000 company to exploit seaweed in Nairnshire for animal feeding stuffs. This includes a "new type of drying plant" similar to that used for tea drying in India, which will speed up the extraction of moisture without impairing nutritive value. There will be cutting sheds, drying rooms and a mill, (near Nairn).

262 Jackson, P. Scottish Seaweed R.A.Report No.89.1947

REPORT ON INVESTIGATIONS AT UIST ON THE VARIOUS METHODS OF AIR DRYING.

263. Jackson, P. Scottish Seaweed R.A.Report No.83.1947

THE DRYING OF CERTAIN SPECIES OF SEAWEED IN A ROTARY LOUVRE DRYING PLANT. Effects on efficiency of the piece size of the weed.

264. Jackson P., Mackenzie Scottish Seaweed R.A.Report.72.1946
COMPARISON OF CERTAIN METHODS FOR THE AIR DRYING OF LITTORAL WEEDS. Comparison of 9 open air methods. Graphical illustrations of results.

265. Jackson, P. Chem.Age 10 Sept.1949 61 No.1574 p.347.
UTILISATION OF MARINE ALGAE. Effective harvesting remains the chief problem. Includes brief description of the extraction of the various useful constituents.

266. MacLean, A. C., White, T. T. Scottish Seaweed R.A.Report.No.92. 1947
THE DRYING OF SEAWEED. Investigations carried out at the Royal Technical College, Glasgow. Equilibrium moisture contents and drying rates in atmospheric and hot air conditions were determined for whole and ground material. Effects of layer thickness. Design and construction of a through dryer suited to all the different aspec of the problem. Drying time is reduced considerably by increasing surface area.

267. Marshall, S. M., Newton, L. H.M. Stationery Office 1949
Orr, A. P.
BRITISH SEAWEEDS AND THE PREPARATION OF AGAR.

268. ---- B.I.O.S./JAP/P.R./814 G.H.Q., S.C.A.P.
THE JAPANESE AGAR AGA INDUSTRY. Extract from Seaweed is precooled i trays 3 ft. x 1 ft. x 3 inches deep, 14 litres. This gelidium is left for 7 hours, temp. falls to 40°C, jelly solidifies and is cut into slabs. The p.H. must be at 7.0 for this. The slabs (or shredded material) is put in trays which are stacked for 2 or 3 days for preliminary freezing and hardening. Then trays are spread out. Slow freezing at night and thawing and evaporation by day. Ice crystals form and melt and run away with impurities from the tilted trays. Takes about 2 weeks.

Sewage

269. Anon. C.T.Jnl.127 p.1263.1 Dec.1950.
SEWAGE SLUDGE DEWATERING. Combined chemical and freezing process. An acc. of the preliminary experts carried out at the L.C.C. Northern outfall.

270. ---- Blackburn Corporation
GRASS DRYING BY USE OF SLUDGE GAS. See under "Green Crops".

271. Downes Water & Sewage Works 93 323-4.1946
Sludge is dried from 5% slurry for 12½ dollars a ton by a spray dryer. If concentrated first to 25% solids, no auxiliary fuel would be required.

272. Gordon, C. W. Comb. Eng. Co. Inc., Chicago — Chem.Eng.Progr.45 8.477-481 Aug.'49
FLASH DRYING. Incl data for drying Sewage Sludge Filter Cake, practiced in U.S.A. for fertiliser and fuel. (1725 B.T.U. used per pound of water evaporated.)

273. Van Kleck — Sewage Works Jnl.17 1240-55 1945
OPERATION OF A FLASH DRYER.

274. Knapp — Sewage Works Engr.and Munic.Sanit.17 245. 1946.
Sludge is reported to have been dried in a superheated steam atmosphere.

275. Komline, T. R. — Sewage Works Jnl.19 No.5.806-810 Sept 1947 Abstr.in Chemie & Industrie 61(2) 2/1949.
EXPERIENCES WITH THICKENING AND DRYING OF SLUDGE. A difficult problem. Ranges from simple elutriation to incineration. Vacuum filtration is interesting, but is possibly assisted by a new kind of filtering tissue.

276. Mitchell, E. K. — Inst.of Fuel."Drying Study"March 1951.
THE DRYING OF SEAWEEDS. The types of seaweed around the British coasts, the harvesting and drying techniques of the useful Phaeophycae are discussed. The importance of avoiding pockets of fermentation, and scorching. Rotary dryers, grass dryers and malt kilns have been used. Also vegetable dryers. The difficulties attached to the transport or storage of weed are indicated.

277. ---- — Nichols Eng.& Research Corp.
DRYING FOR FUEL. See under Waste Materials.

278. Smith, A. R. — Combustion II(5)25-29.Nov.1936.
FLASH DRYING SLUDGE. See under "Pneumatic Drying".

279. Wishart, Jepson, Klein — Jnl.Sewage Purification 1(110)138 Br.Chem. Abstr.BIII Aug.1948.234.
Dewatering of sludge by coagulation and vacuum filtration. Laboratory expts.

Slurry

280. ----
SLURRY. See under "Cement" and "Clay".

281. Bar, P. J. B.P.593,380/1947

DRYING PROCESS AND APPARATUS. Claim 1:- A continuous drying proces which comprises spreading a paste, slurry or viscous liquid by extrusion on a solid surface in a thin layer, exposing this layer to the action of a hot gas until it is converted into a friably damp material, breaking up this material into non-sticky particles, causing these particles to become airborne in the hot gas and finall drying the particles to dry powder in a pneumatic drier in floating contact with the hot gas.

282. Kimberlin, C. N., Pierce, J. A. U.S.P.2,443,462.1948.BI.442.
Std. Oil Dev. Co. June 1949

DRUM DRYER FOR HYDROGEL CATALYSTS. A slurry is fed to the inside of a rotating drum through which inert gas not higher than 150°C passes, and dries the slurry, the dried material being brushed off the upper surface into pans.

283. Trumpelmann, E. Montanistische Rundschau 26, 6p.(1934)
supp.in Eng.in Collier Guardian 148,490
(1934)Mar.16.

SIEBLOSE ENTWASSERUNGS SCHLEUDER FUR SCHLAMM UND FEINKORN. Sieveless dewatering centrifuge for slurry and fine coals; product to be dried is not projected against sieves, but against walls of drum rotor, centrifuged water flowing off the dewatering cavities or orifices projecting into coal; this obviates sieve wear and keeps percentage of solids in waste water very low.

Soap. Detergents

284. ---- B.I.O.S. Report No.887

SPRAY DRYING EQUIPMENT FOR SOAP AND CLEANSERS.

285. ---- Heat.& Vent.Engr.21(251)480 May 1948

SPRAY DRYING SOAP

286. ---- International Industry Oct.1947

RECENT DEVELOPMENTS IN SOAP TECHNOLOGY.

287. Berti Soap.Sanit.Chemicals 23(5)38-40.1947.

VACUUM SPRAY DRYER FOR DRYING AND CHILLING SOAP.

288. Bradshaw, G. B. U.S.P.2,452,724.2/11/48 Chem.Abstr.43.
1586.25/2/49.

CONTINUOUS SOAP MAKING PROCESS. Fatty acid esters are ester exchanged using e.g. methyl alcohols. Saponified continuously with caustic soda, spray dried at 27 in. mercury pressure giving soap and methyl alcohol.

289. Clegg, L., Jackson, S. V. Inst.of Fuel, "Drying Study".March'51
THE DRYING OF PASTES POWDERS AND CRYSTALS. Soap. The stock is run over chilling rolls, scraped off, and the soap is then carried in strip form on endless belts to a wire mesh band in the drying chamber. Heat balance given.

290. Kastens, M. R., Ind.Eng.Chem.41(10)2085 Oct.1949
Hansen, F. R.
DRIER SOAP MANUFACTURE. Paragraph on Dehydration. After washing the precipitated soap (Cobalt), the ppt. is heated 4-5 hours at 210°F to drive off the entrained water, and 3 hours to raise the batch temp. to 300°F for complete elimination of water. Hood ventilation. Moisture contents in ppt. 30-40%; in dry soap 0.5%. The soap as a hot liquid is pumped off.

291. Lederer, E. L. Seifensieder-Ztg.51 774 & 779 1924
CALCULATIONS FOR THE DRYING OF SOAPS.
Application of diffusion equations to drying. See additional references to work of Lederer in paper by A. B. Newman. Am. Inst. Chem. Eng. Aug. 1931.

292. McBain, J. W., Lee, W. W. Ind.Eng.Chem.35 784-787.1943
SOAP CURD. WATER VAPOUR SORPTION. Ahydrous soap takes up about 1-2% of water by physical sorption. Except for Sodium Oleate, the curd then suddenly forms a hemihydrate, which again takes up water more rapidly (10-15%) until another phase forms, which at low temperatures are higher hydrates, i.e. crystalline fibres containing larger amounts of water. These revert to hemihydrate when humidity falls. The sorption curves shew the presence of capillary liquid in the fibrous mass.

293. Moon, C. B. D. Soap.Perfumery & Cosmetics 20 573-5.583. 1947
Review of types of dryers applicable to the soap industry.

294. Reavell, B. N. Soap, Perfumery & Comestics Nov.1944
THE SPRAY DRYING OF SOAP POWDERS.

295. Slade, F. H. Heat.& Vent.Engr.22(256)p.173 Oct.48
SOAP MANUFACTURE. Generally speaking, mixtures containing less than 40% fatty acids can be spray dried. Mazzoni process (vacuum spray dryer) Scott dryer, (atm.) and Kestner dryer (heated air) are described briefly.

296. Slade, F. H. Chemical Products 13 (5) p.184.Apr.1950
SPRAY DRYING DEVELOPMENTS. Brief description of spray drying of soap. 5 cwt. to 5 tons a day.

297. Smith, M. W. — Inst.of Fuel"Drying Study"March 1951
C.T.J. 3347, 129. 209-10. 27.7.51

SPRAY DRYING OF SYNTHETIC DETERGENTS. Two processes, spray drying and spray cooling. Description of high pressure jet plants, two fluid nozzle systems, and spinning dirc plants. The factors making for high thermal efficiency, and affecting the quality of product. Lines of research are suggested.

Sodium Palconate

298. Forman, L. V. — Ind.Eng.Chem.40 2443-50 1948

SODIUM PALCONATE PRODUCTION. Sodium Palconate is obtained by alkaline extraction of redwood bark, followed by a concentration and spray drying of extract. It is an effective agent in controlling water loss in drilling, and is useful as a dispersing agent.

Sodium Sulphate

299. Brekhovskikh, S. M. — Keram 1.Steklo.6(8) 17 1949 C.A.44 7. 2805.1950

NEW METHOD OF DRYING SULPHATE. Drum preheated with generator gas to 550-600 ^{0}F. The atmo. in the drum is reducing. The sulphate is charged in small amounts till outgoing gases fall to 150^{0}F. Below 150^{0} the moist sulphate sticks to the walls. Sulphate leaves the drum at 90^{0} - 100^{0} and moisture is 1.5% compared with initial 36%. 13 tons a day. Cleaning the drum over 1-1.5 hours.

300. Holland, A. A. — Chem.Eng.pp.106-107.Jan.1951

NEW TYPE EVAPORATOR. A continuous dryer for Glauber salt designed to throw a spray of the salt into an air stream @ 1600-1800^{0}F. and caking on the sides of the apparatus is eliminated. Sodium sulphate containing 60% water is reduced to 24% water.

301. Kemmer, Perfilov — Chimie et Industrie 26,111 Mineral Sui'e 6,190-204(1931)

DRYING GLAUBER'S SALT. Experiments on dehydration of decahydrate.

Starch

302. —— — Sci.Libr.Bibl. Series No.595.1936-1942

MANUFACTURE OF MAIZE STARCH. 41 Refs.

303. —— — Sci.Libr.Bibl. Series No.211 1926-1935

MANUFACTURE OF STARCH. 148 Refs.

304. —— Edgar Allen News. 28(326)353.
ROTARY DRUM DRYERS. Buell Turbo-dryer dries starch with a steam consumption of 1.7 lb. steam per pound of water, reducing moisture from 40% to 20% at a max. temp. of 70°C. Practically no dust carried out.

305. Byron Starr, Clinton Industries Ltd., Clinton, Iowa — Chem. Engg. pp. 92-95 Aug. 1949
MAKING THE MOST FROM CORN. Starch removed from suspension by vacuum string discharge filter. Cake is broken up and passed on belt through tunnel dryer. It enters at 44% M., meets counter current air and emerges at 10-14% M. This is pearl starch and can be ground if required. Lump or Gloss starch is specially cooked, pressed hydraulically and broken up for packaging. (No mention of drying).

305a. Fisher, Br. F.M.R.A. Cereal Chem. 4. 184 1927
A STUDY OF THE RATE OF DRYING OF WHEAT FLOUR, STARCH AND GLUTEN.

306. Hellman and Melven Cereal Chem. 25 146 1948
WATER SORPTION BY CORN STARCH AS INFLUENCED BY PREPARATORY PROCEDURES AND STORAGE TIME. Data given on water sorption of ten corn starches at R.H. 12 to 93%. The ten starches, although differing in origin and preparation, all shewed essentially the same sorption. A table relating R.H. and moisture content is given.

307. Kröner, W. Z. ges. Getreidew., 1939, 26, 162. Chem. Abstr., 1940, 34, 1755
HERSTELLUNG UND BEURTEILUNG VON KARTOFFELSTÄRKEMEHL. Gives an illustrated description of the process and equipment used in manufacture of potato starch flour. Discusses methods of evaluating the quality of the product.

308. Oxnam, J. S. B.I.O.S. Report No. 1559
STARCH ADHESIVES.
p.4-5 Roller dryer
p.13 Starch. Blocks from compressed air filters are fed to breaker at the top of a Buttner Turbo-dryer. 40% moisture is reduced to 11% at a max. temp. of 59°C.

309. Paine, H. S., Thurber, E. H., Balch, R. T. — Ind. Eng. Chem. 30(12)1335-45. 1938
MANFR. OF SWEET POTATO STARCH IN U.S.A. After bleaching etc., the liquor is dewatered by the perforate-basket centrifuge to about 35% water, and dried in a vacuum dryer to about 12% at a definite p.H. P.1345 - Kiln dryers. Vertical Turbo-dryer should be satisfactory. Care in drying to avoid hard lumps, but no details.

310. Sair, L. Ind.Eng.Chem.Anal.14 843-5.1942
STARCH MOISTURE. DETN. Results compared, on detns. on 22 commercial starches by distillation, vacuum and air oven methods. Conclusion that toluene distillation and vacuum method at 100°C are suitable as reference methods. 140°C may be suitable for rapid detns., but, care should be taken with acid modified starches. Water held more tenaciously in the latter than with original starch.

311. Schrenk, W. G., Andrews, A. C. Ind.Eng.Chem.39 113.1947
King, H. N.
STARCH. Heat of hydration measured by calorimetric method.

312. Treadway, R. H. Ind.Eng.Chem.40 1402.1948
BATCH AND CONTINUOUS PROCESSES FOR POTATO STARCH.

Sugar

313. Anon. Facts About Sugar v 29 n 7 July 1934 p.229-30
TURBO DRYING OF REFINED SUGAR. Apparatus installed at German refinery for cooling has been found effective also for drying; method designed to produce sparkling crystals; dust problem in sugar drying; experiments with turbo drier.

314. Anon. Sugar 45 5.38.1950
HYDRAULIC CENTRIFUGAL STAGES A COME-BACK.

315. Ambler, C. M. Chem.Eng.Progress.44(5) 1949 Trans. Am.Inst.Chem.Engrs 405-10-1948.
ATTEMPT TO DEVELOP THEORY OF CRYSTAL DRYING.

316. Basu, K. L. and Mukherji B.K. Proc.Sug.Tech.Ass.India,1940,Part II, p.239.Chem.Abstr.1941,35,5738.
HYGROSCOPICITY OF DIFFERENT SUGARS. Hygroscopicity of sugars is an inverse function of the purity. Pure sucrose can be stored safely at a relative humidity of 65% and a temperature between 30° and 35°C. The presence of glucose and ash is less injurious than laevulose produced by inversion. At and below 75% relative humidity (at the same temperature), sucrose and glucose showed a marked tendency to attain an equilibrium, below which moisture is not reduced by lowering the relative humidity. About 75% relative humidity, moisture, once absorbed, is not lost by changes in relative humidity.

317. Burgdorff. W., Archiv fuer Waermewirtschaft, 12, No. 9, Sept. 1931, pp. 261-262, 1 fig.
ABWAERMEAUSNUTZUNG IN TROCKENANLAGEN DER ZUCKERINDUSTRIE (WASTE-HEAT UTILIZATION IN DRYING PLANTS OF SUGAR INDUSTRY). Advantages and possibilities of waste-gas drying plants in sugar factories; their significance for older boiler houses; heat flow of plant with supplementary furnace; test results.

318. Hobbs, J. E. Inst. of Fuel "Drying Study", March 1951
THE DRYING OF GRANULATED SUGAR. An account of the drying of the centrifuged sugar in rotary dryers. Construction details are given. The dryer is provided with flights and air-flow is counter current.

319. Magee, J. H. Inst. of Fuel "Drying Study", March 1951
THE MIGRATION OF MOISTURE IN GRANULATED SUGAR. Rotary drying. Packaging. Equilibrium moisture content and moisture changes in a bulk of sugar. The moisture moves to the walls of the tank and prevents proper discharge by causing adherence to the walls. Cooling of the warm dried sugar before loading gave satisfactory results.

320. Clegg, L., Jackson, S.V., Inst. of Fuel. "Drying Study", March 1951
SUGAR-STARCH SYRUP. The Drying of Pastes, Powders and Crystals. A heat balance is given for spray drying the above.

321. Food Concentrates Inc., B.P. 608, 137.22.8.45.B.III.137 March 1949.
DRYING HYGROSCOPIC PLASTIC MATERIAL CONTAINING SUGAR. The hot dried material is agitated as it is removed from the drum by the doctor blade. Effected by passing the material on to flow plates over which move smaller blades like a car windscreen wiper. R.H. of atmosphere should be less than 33%.

322. Kunert, F. Listy Cukrovar, 1948, 64, 267-268; Int. Sug. J., 1949, 51, 228.
DIELECTRIC DRYING OF SUGAR. Sugar cubes were dried from 2.6 to 1.5% of H_2O in 25 minutes between metal plates using an electronic generator of 200 w. and 1500 kilocycles. The efficiency was 50% with this experimental equipment.

323. Maushake, H., Stahlbau (Supp to Bautechnik) 7 No. 26 Dec. 21 1934 p. 204-6.
STAHLBAUTEN FUER TROCKNUNGSANLAGEN FUER ZUCKERFABRIKEN. Examples of design of steel structures of drying plants of sugar mills.

324. Mitchell, T. J., Chem. and Ind. No. 51. 815-7. 23 Dec. 1950
DETERMINATION OF WATER IN SUGAR SOLUTIONS BY DESICCATION AT ROOM TEMPERATURE. Drying over desiccating agents (in vacuo) is recommended as the standard method.

325. Peter, R., Stapel, W.M., Lendorff, B. Escher Wyss News. No. 25015(a) 19/20 1946/47 20.pp.
THERMO-COMPRESSION IN SUGAR FACTORIES. A graphical, and diagrammati treatment of the application of heat pump to evaporation of sugar solutions. Photographs shewing constructional details.

326. Schouten, A., Parashar, D. R. Proc. Sug. tech. Ass. India, 1940, Part I, p. 185 Chem. Abstr., 1941, 35, 5739.
DRYING OF SUGARS AND MAINTENANCE OF LUSTRE OF DRIED SUGARS. Formation of dust and loss of lustre can be prevented by controlling the temperature inside the drier and the amount of air passing through in such a way that the drying is just complete as the sugar leaves the apparatus.

327. Slade, F. H. J. Inst. of Heat and V. Engr. 8/1948 22(254) p. 58.
Short description of sugar drying.

328. Starr, B. Chem. Eng. pp. 92-95 Aug. 1949
Clinton Industries Ltd.,
Clinton, Iowa.
MAKING THE MOST FROM CORN. For sugars, the object is to convert the corn starch to a complete yield of dextrose as far as possible. Sugars are crystallised, centrifuged, and dried in rotary dryers. No particulars. Crude sugar is cast in molds from partially refined sugar liquors and contains mother liquor and non-sugar compounds. The hydrolysed starch (HCl) is partly concentrated by triple effect vacuum evaporators, decolorised, and concentrated to the desired S.G. in a single effect vacuum evaporator. A new process for dried corn syrup introduces the thick syrup into a large vacuum drum and then fed between two steam heated cr. plated rollers, and emerges for packing as a dry white solid containing less than 5% M., after scraping off the rolls.
Principally dextrose and maltose.

Sulphite Liquor

329. Fogler, H. H. et al T.A.P.P.I. 32 389-393 1949 BII
SPRAY DRYING COEFFICIENT FOR SULPHITE WASTE LIQUOR. Sulphite Waste Liquor was spray dried with furnace gases at 3, 4, 5, and 600° F. and heat transfer coefficients calculated. The coefficients were relatively unaffected by the type of atomisation (disc or nozzle).

330. Heath, L.R., Hill, H.S. Pulp Pap. Mag. Can., 1949, 50, No. 8, 89-94.
ELECTRICAL EVAPORATION OF WASTE SULPHITE LIQUOR. Experiments based on the use of pilot plants having evaporative capacities of up to 2.5 tons of H_2O per day indicate that the method is suitable commercially, the economics being very favourable where secondary electrical power is available and the conc. waste liquor is used for fuel. The equipment is detailed.

330a Ramen, Torsten. Svensk Papperstidn. 49 418-22. 1946
RECENT EXPERIENCE IN THE EVAPORATION AND BURNING OF SULPHITE WASTE. A description of the installations for evaporating sulphite liquor, and results of the process of burning the dried material.

331. Swenson, Evaporator Co. Chem.Eng.News 27(10) 671 7 Mar. 1949
Diagram of Spray Dryer for Sulphite Liquor.

Tar

332. Vilesov, A. A. U.S.S.R.P. 66,658/1946; Chem. Abstr., 1947, 41, 1832.
DEWATERING TARS, OILS, ETC. To dewater a tar emulsion it is cooled and then passed through a previously dewatered product. Drops of tar in the emulsion dissolve thereby in the dewatered tar.

333. Friederich, L. A. Am. Gas. Jnl. 170(1) 26-7 1949
TAR DEHYDRATION. The most common methods for breaking tar emulsions or the dehydration of tar are the use of the open-type boiling tank and of a pressure still.

Waste Materials

334. Anon. Chem. Age, 13 Dec. 1947, 57, 756.
FLASH DRYING: WASTE RECOVERY WITH LITTLE PROCESSING. The waste material is extracted by a turbulent stream of air at a temperature of the order of 1 300°F. The system has proved satisfactory for rejects from coal washeries. B.C.U.R.A.

335. Cooley, L. C. Ind. Eng. and Chem. 30 (6) 620. 1938
DISTILLERY BY-PRODUCTS. DRYING. Steam Tube rotary dryers. Each dryer can remove 6,000 lbs. moisture per hour.

336. Gordon, C. W., Chem.Eng.Progr. 45 8 477-481 Aug. 49
Comb. Eng. Co. Chicago.
FLASH DRYING DISTILLERS GRAINS. Including data for the flash drying of distillers grains and corn products. (1750 B.T.U. Per lb. water evaporated). Diagrams of drying systems.

337. Hermann, R., Izsak, J.A. Canad.Chem.33 211-12-15 1949
Bercuson, N.
RECOVERY OF DISTILLERY RESIDUES. 35-50% of original grain remains unused after alcohol production. 40% of this is recovered by screening, the remainder is spray dried, and produces 1600 lb. drie solubles per hour at 3% moisture from a feed containing 80% m. Source of heat is fuel oil.

338. Kohlins, W. D., Chem.Eng.Progr.46 12 597-600
Demarest, E. L.
WASTE UTILISATION AND DISPOSAL SYSTEMS. Includes an assessment of the costs of evaporation and drying waste materials for easier or harmless disposal. Illustrated.

339. Nichols Eng. and Res. Corp. B.P.597,156/1948.
FURNACES AND METHOD FOR TREATMENT OF WASTE MATERIAL OR THE LIKE. This relates to apparatus and methods for drying and incinerating waste materials. The invention is particularly adapted for incineration of municipal refuse and the concurrent drying and/or incineration of dewatered sewage sludge.

340. Nordstrom Paper Trades J 80,49-60, (1925).
DRYING WOOD REFUSE. Test data on Nordstrom Dryer.

341. Ridgeway, J. W., Proc.3rd Ind.Waste Conf.Purdue Univ.Eng.
Baldyge, W. V., Bull.Extension Service Ser.64 128-37
Scarba, M. (1947).
SPRAY DRYING OF DISTILLERS SOLUBLES. Fermented mash residue (stillage) containing approximately 20% - 30% solids is spray dried in a blast of hot boiler-flue gases at 450°F. reducing moisture to 3 - 5%. Heat economy results from the normally wasted hot flue gases. Vitamins and natural products are preserved for stock feeding.

342. Smith, A. R. Combustion 11(5)25-29.Nov.1939.
FLASH DRYING DISTILLERS GRAINS.

343. Spanyer, J. W. Chem.Eng.Progr.43 523-6.1947
RECOVERY OF DRIED SOLUBLES FROM THIN STILLAGE. Description of evaporation process and drying operation. Details of drum dryer and methods of operation.

344. Whalley, M. E. Nat.Res.Council Publ.1285 103pp.7/1945
Canad.Chem.Proc.Industr.29 576 July 1945
Abstracts on Utilisation of Sawdust. Contains 160 abstracts and 152 patents.

Zein

345. Manbre & Garton, Ltd., B.P.620,011, 1.1.47
Baker, B.P. and Pryce, N.A.C.
PRODUCTION OF ZEIN AND SOLUTIONS THEREOF AND ZEIN-CONTAINING PROLAMINES. A relatively stable and none-gelling alcoholic solution of zein is prepared by removing the starch from 200 pts. of wet maize gluten (containing protein 60, H_2O 102 and starch 38 pts.) by one of the following treatments; (a) heating at 100^0 for 3 hours with 200 pts. of H_2O containing 0.5% of HCl, or in a closed vessel with 400 pts. of H_2O containing 6% of SO_2, (b) autoclaving at 30 lb. pressure for 50 minutes with 600 pts. of H_2O containing 0.15% of HCl, or (c) making a paste with 100 pts. of an aq. extract of malted barley (20 pts.). The resulting mixture is filtered, and the residue, after drying and grinding to a powder, is extracted with 120 pts. of PhMe to remove the oil. The dried residue (1 pt.) is extracted at 60^0 for 2 hours with 2 pts. of methylated spirit, and the filtrate is decolorised with charcoal, concentrated to 14% of solids content, and clarified, after keeping, by filtration or centrifugation.

346. Rongstead, W. C., Indust.Eng.Chem.33 1544 1941
Gottfried, J. B.,
Swallen, L. C.
DRYING HEAT SENSITIVE SUBSTANCES. ZEIN. A modified flash drying system is described. This is a combined grinding and pneumatic system (Raymond flash drying system) designed to prevent sticking of the particles of zein before completely dry. The maximum temperature permissible is $15^0C(60^0F)$.

Zeolites

347. Larian, M.G., Mann, C.A. Indus.& Eng.Chem.28 No.2 Feb.1936 p.196-200.
DRYING GEL ZEOLITES. Effect on base-exchange capacity and hydration; zeolites were air-dried under various conditions of temperature, humidity, and velocity; zeolites of varying composition were also prepared and dried under identical conditions; percentage of fines is increased when drying is very rapid or when gel is overdried; base-exchange capacity depends upon conditions of drying; explanation of this behavior. Bibliography.

Unclassified

348. Starr, Byron
Clinton Industries Incorp. Chem.Engg. pp. 92-95 Aug. 1949.
CORN PRODUCTS. See under Gluten
" " Starch
" " Sugar
" " Pneumatic Drying.

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349. Taylor, R. Soc.Chem.Industry - J.(Trans. & Communic
tions)53 No.25 June 22 1934 p.193T-4T

ALCOHOL. USE OF CARBON TETRACHLORIDE FOR DRYING HIGHER ALCOHOL MIXTURES. Method of drying alcohols involving combinations of extraction and distillation which is believed to constitute novel and improved method; alcohols were first extracted with carbon tetrachloride, by which process large portion of water was removed.

350. ---- Int.Sugar J.321-4.1946

RUM. Evaporation of slop to 60% solids by atomisation.

351. ---- Nat.Petrol.News,7 Nov.1945,37,869-70

BUTANE DRIER IN ALKYLATION PLANT SAVES 5 TONS OF CATALYST A DAY. A low cost, high capacity separator is described. Liquefied butane feed for an alkylation unit is passed through a grid of wood shaving (excelsior) and entrained water is dropped out. The water content is reduced from an inlet value of 0.02-.03 to 0.008-.011 volume per cent on the outlet side, of which 0.005 to 0.007% is undissolved water.

352. Derr, R.B., Willmore, C.B. Ind.Eng.Chem.,31,866-8(1939)July.

DEHYDRATION OF ORGANIC LIQUIDS WITH ACTIVATED ALUMINA.

353. Duncan, D.M., Wright, F.S. U.S.Pat.2,393,521 22/1/46

A GAS FIRED TUNNEL DRYER FOR GLASSWARE IS DESCRIBED.

354. Marz, A., Rutgerswerke Chemie.Engenieur-Technik 1949 C.T.J.
Duisberg-Meidereich. p.464.124(3229)22/4/49

PHENOL-DEHYDRATION PROCESS. A process has been developed by the above firm for the continuous dehydration of crude tar-phenol by heating in large sized gas heated retorts.

355. Matrozova, S. Myasnaya Ind.S.S.S.R.1939.10(No.8),32
Chim.et.Industr.,1940,43,151,Chem.
Abstr.,1940,34,3522.

EFFECT OF DIFFERENT SALTS ON THE DEHYDRATION OF FAT (transl.title). Sodium Chloride and alum were found to be the salts which facilitate most the separation of moisture from fat on prolonged standing. But if the fat contains more than 1.5% of water, there remains in th product more than 0.2% water, even after standing for 6 hours in presence of sodium chloride or alum. Alum was more effective than sodium chloride but its cost is higher.

356. Pfetzing, A. J. Gas Age,29 Nov.1945,96,No.11,13-14.

FLAME CLEANING OF STEEL USING GAS. A method of scaling and dehydrating steel before repainting by using low pressure gas torches utilizing town gas at 4oz. pressure and compressed air at 60lb. or over is described.

357. Young, H.E.B., Binks, S.C.H., B.I.O.S.1522
Hunter, W.

METHYL CELLULOSE. p.58. - Hydroextractors. p.59 - 3 Schilde Rotary Dryers 130°C. inlet, 40-50°C exit. p.60 - Buttner Turbo - Dryer (Rust contamination). (Details of capacities, power consumption are given.)

LEATHER

General

358. Dept. of Vet. Services, Kenya — E. Afric. Agric. Jnl. 16(2)86-7, Oct. 1950
NOTES ON SHEDS AND EQUIPMENT FOR DRYING HIDES AND SKINS. An account of cleaning, mechanical and ventilating and crowding aspects of drying freshly flayed hides and skins.

359. Anon. — C. Tr. Jnl. 16 Sept. 49. 125 No. 3250 p. 362
A MODERN TANNERY. (Randak Tannery of R. & A. Kohnstamm Ltd.) After tanning and splitting, two methods of drying are practiced. 1. Hides stretched on a wire frame to prevent shrinkage and given a "hard" drying at 140°F. 2. (Paste drying). Hide fixed to a plane surface by adhesives before passing through drying chamber. The dried leather, which is extremely stiff, is damped and machine worked on "staking" machines to restore flexibility before passing to the finishing section.

360. ---- — Communicated, American Source, 18 Nov., 49
UPPER LEATHER. After dehairing and defleshing, hide is soaked in acetone, methyl ethyl ketone, or methyl alcohol and then vacuum suctioned. Chrome or other tanning agents are then used, and tanning is completed in 4-6 minutes. Assured that satisfactory leather can be made by this process.

361. --- — B.I.O.S. Rept. No. 150
LEATHER PRODUCTION (IN GERMANY).

362. Bowes, Kenten — Biochem. J. 43, 358, 1948
THE CHEMICAL STRUCTURE OF COLLAGEN.

363. Bradley, H. — J.I.S.L.T.C. Dec. 1932. 584-591
STATISTICS AND LEATHER SAMPLING.

364. Cutter, W. M., United Shoe Mcy. Corp. — U.S. Pat. 2,438,150. Chem. Abstr. 42, 3984. 10.6.1948
SOAKING, FREEZING AND DRYING BY SUBLIMATION OF FRESH HIDES.

365. Fleisher, W. L. — Heat. Piping and Air Conditioning v 4 n 11 Nov. 1932, p. 719-21.
DRYING. ESSENTIAL PROCESS IN INDUSTRY. Proper control and application of temperature and air circulation required in many processes on leather drying; methods of creating conditions conducive to drying.

366. Hersdorf Das A.B.C. der Schuhfabrikation.
2 Nov. 1932
DRYING IN THE SHOE INDUSTRY. Gives guidance as to the best factory conditions. Engl. summary in S.A.T.R.A. Inf. Circ. No.5.

367. Huggett, L. P. S.A.T.R.A. Technical Memo. No. 1032. 1950
THE DRYING OF MINERS BOOTS IN STANDARD AND MODIFIED CLOTHES LOCKERS.

368. Edwards, R. S. Br. Boot, Shoe and Allied Trades Res. Assn. Report No. 36. Nov. 1930
THE EFFECTS OF MULLING AND DRYING ON SHOE MATERIALS. The results of the experimental work carried out leaves little doubt as to the usefulness of the process.

369. Humphreys, F. E. Inst. of Fuel Drying Study. 9 March, 1951
THE DRYING OF LEATHER. Description of leather itself and the general nature of the operations in manufacture. The special problems in leather drying, microstructure moisture movement and relations. Curves are included. Loss in area on drying, general methods of drying, equipment and efficiency (0.7 to 1.3 lb. solid fuel per lb. of finished leather, for driving off an equal quantity of water). More modern practices in leather drying. The most common method is still the controlled shed. 17 Refs.

370. Keep, W. F. Australasian Leather Tr. Rev., 1947, 43, 135
16 April, 1947
LATTER-DAY DEHYDRATION ENGINEERING IN APPLICATION TO THE PROBLEMS OF LEATHER DRYING. A paper given at a meeting of the Australian Section of the I.S.L.T.C. The mechanism of the air drying of a solid was considered; the disadvantages were stressed of drying leather too rapidly - case-hardening and movement to the surface of water-solubles. Rapid drying at high humidity and temperature was recommended, followed by temperature reduction on reaching the falling-rate stage. Difficulties experienced in experimental leather drying were described: air leaks in the cabinet were a source of trouble, especially owing to the pressure differences produced by circulating fans. If sole leather containing concentrated liquor were dried rapidly at low R.H., water-solubles migrated to th surface. If high R.H. and high temperature were employed, drying took place throughout the leather; the temperature employed was regulated by the properties of the leather, as heat damage must be avoided. Sole leather had been dried in 36 hours with good colour.

Chrome tanners considered that, with certain grades, it was advantageous to dry to a very low moisture content and then to recondition. A speaker thought that there was greater surface shrinkage with rapid drying than with slow drying; also that firmness was associated with rate of drying - slow drying produced a mellower leather. This view was not generally agreed with; another speaker thought that the "feel" of the softer types of chrome leather depended considerably on the rate of drying. S.E.F.

371. Kennedy, S. J. J.Amr.Leather Chem.Ass.44,258-270,1949
Quartermaster Research Programme on Leather.

372. Levenko, P. I. and Legkaya Prom.No.11,21 Nov.1948
Arbutzov, S. V.
NEW METHOD OF CURRYING AND DRYING RUSSIA LEATHER. Drying on frames or pasting boards. See B.L.M.R.A. Monthly digest, p.73A. May 1949.

373. Litvinov, M.R. and Legkaya Promyshlennost No.5,p.10,1949
Kovtunovich, S. D.
DRYING TANNED TUFT LEATHER.

374. Moore, J. W. and Trans.Amr.Inst.Chem.Engrs.36.579-592.
Wilbrandt, F. C. 1940
DRYING OF FIBROUS MATERIAL. 1. Vegetable Tanned Leather.

375. Orthmann Hide & Leather Publ.Co.New York,1945
TANNING PROCESSES.

376. Otto Das Leder 1,153.1950
Chrome tanned leather is not readily wetted by water after drying and the chromium salts cannot be washed out.

377. Pittard, C. J. J.I.S.L.T.C.29.199.204.1945
(C.W.Pittard & Co.Yeovil)
LEATHER DRYING. Experience with Gloving Leather. General description of drying treatment.

378. Sherwood, T. K. and Chem. & Met.Eng.v.42 n 10 Oct.1935 p.539
Gareno, L. E.
DRYING HEAVY LEATHER IN FIVE HOURS. Process developed by authors (patent applied for); wet leather is coated with thin layer of kiesel guhr-water paste; as coated hide is dried, water is drawn by strong capillary pull of kieselguhr, evaporating at outer surface of coating; it is possible to dry leather at temperature as high as 180 °F without injury of product; kieselguhr may be recovered after drying.

379. Smith, P. I. Hide and Leather and Shoes, 1945, 109, No. 30, 37, via Chem. Abs., 1945, 39, 5111.10.11.

DRYING OF LEATHER BY USE OF RADIOFREQUENCY HEAT. Semi-chrome and full-chrome kips could be dried properly in 1 min. with a power out-put of 1 kw. at a frequency of 100 kc. The leather was of good quality but dark in colour. The process is expensive but has the advantages of saving in time, close control of conditions, and no fading of dyestuff.

380. Stephens, C. Br. Leather Mnfrs. R.A. Report Nov. 1943. Leather World Nov. 1943

CONTROLLED LEATHER DRYING. It is recommended that a system of drying be adopted which is based on the principle of maintaining continuously the temperature and humidity which obtains when the weather is at its best for the natural drying of leather. Adequat insulation of the drying chamber is essential.

381. Stevens, C. Fuel and the Future 1948, p. 292-3

LEATHER DRYING. Attempts to remove the drying bottleneck by careful arrangements. Great strides in economy in fuel consumption in recent years.

382. United Shoe Machinery Corp. B.P. 572, 367, Oct. 8, 1943. B. II. 66. 1946

DRYING OF HIDES, SKINS AND LEATHER. A method is described for drying frozen hides, raw or tanned, by sublimation in a current of water absorbent gaseous medium.

383. Weisselberg, A. Chem. & Met. Engg. 45. 418-421. 1938

CHEMICAL DEHUMIDIFICATION OF AIR. Excellent use of this method in the drying of leather and other articles.

384. Wilson, J. A. Reinhold 1941, Chapman & Hall, 1944

MODERN PRACTICE IN LEATHER MANUFACTURE. Chap. 16. Drying light leathers and mechanical operations, pp. 518-555. Chap. 18. Drying heavy leather, pp. 620-621. (No ventilation at first, so as to avoid oxidation). Chap. 19. Properties of leather p. 655. R.H. vs. Tensile strength, p. 664. Permeability: Effect of R.H. Porosity and rate of passage of air.

Infra-Red Drying

385. Anon. Mon. Bull. Brit. Boot, Shoe, and Allied Tr. R.A., 1947, 3, 169. May, 1947

INFRA-RED DEVELOPMENTS IN THE BOOT AND SHOE INDUSTRY. An apparatus for drying, by means of infra-red rays, nitrocellulose cement and bottom and edge finishes of shoes has been developed. Eight pairs of shoes are dried simultaneously; time of drying cement and the two finishes is 2 min. for each process.

386. Anon. Elect. Wld. 15 Mar. 1947, 127, No. 11, 120
INFRA-RED DRYING USED IN TWO SPECIAL APPLICATIONS. Two installations, one for insulation drying (armatures) the other for drying hides are illustrated. The first uses two banks of eighty 375 w. lamps; the second has two banks of thirty 125 w. lamps.

387. ---- D.S.I.R. Report 1948-9. H.M.S.O.
The British Boot and Shoe Research Association has shewn that with Infra-Red Dryers, the drying time for adhesives between sole and upper leather is reduced from 30-40 minutes to 2 mins., and similar savings for bottom, point and edge stains. Already in use in factories.

388. Deriberé, M. Doc. Sci. Tech. Ind. Cuir, 1946, No. 1, 9.
January, 1946
DRYING OF LEATHER BY INFRA-RED RAYS. References are given to previous general work on the application of infra-red rays to drying, and also to previous experimental work on the drying of leather by this method. It seems already clear that infra-red rays may possibly prove a rapid and cheap way of drying leather. The author quotes one of his own experiments in which chrome-tanned cow hide, 2 mm. thick, containing 50 per cent water was completely dried in 35 min., and other experiments in which a sample of horse hide from the setting-out machine, containing about 65 per cent. water, was dried in 30-35 min. at a temperature of 70-80°C.

389. Deriberé, M. Rev. tech. Ind. Cuir, 1948, 40, 125-8. June, 1948
USE OF INFRA-RED RAYS IN THE LEATHER AND FOOTWEAR INDUSTRIES. Infra-red drying in the leather and footwear industries is now passing out of the experimental stage. It has been found to reduce the time taken to dry footwear in the course of manufacture by from 15-30 min. Types of apparatus are described, with numerous illustrations. Mention is made of the possibilities of use in the drying of finishes, and of a drying tunnel for pigmented leathers. 10 Refs.

390. Deriberé, M. Bull A.F.C.I.C. 11. 177-86 Oct. 1949
INFRA-RED RADIATION IN THE LEATHER INDUSTRIES. A review.

391. Franceschi, R. Cuoio, Pelli. Mat. Conciante. 25. 38-40. 1949
Chem. Abstr. 43, 9505. 1949
DRYING HIDES BY INFRA-RED RAYS. A plant is described for drying hides with infra-red lamps of 250 watts, the temp., near to the hides is about 90° and at the air outlet is 30-48°. The drying process, 10-50 min., gives good results, but some colours are slightly decolorised.

392. Gastellu, C. and Julien, I. Bull. A. F. C. I. C., 1948, 10, 115 and 128. August, 1948

DRYING WITH INFRA-RED RAYS. Tests were made on vegetable, alum, an chrome-tanned leathers by drying them in infra-red cabinets. Resul show that infra-red drying is definitely unsuitable for vegetable-tanned leather, but appears to be quite satisfactory with alum-tanne and chrome-tanned. The vegetable-tanned and alum-tanned leathers were tested in a cabinet having 4 lamps of 250 w., the goods being placed 30 cm. from the lamps, and the leather treated first on one side and then the other; the average temperature on the leather was 45°C. The chrome leather was tested in a special Mazda cabinet having a double row of 18 lamps of 250 w. which allowed both sides o the leather to be dried at once. The distance from the lamps was about 50 cm., and the average temperature on the leather when the cabinet was kept closed reached 70°C. The time of drying was 3 hr. for the vegetable-tanned leather, and 1½ hr. for the others. The cost of drying leather by this method is very high. It is suggeste that the method could be adapted for the drying of pigment finishes, the finishes being applied by spray, and the leathers then passing straight into the drying cabinets on the endless band principle. In a discussion, it was pointed out that the alum-tanned skins, thoug dried at a higher temperature than is usual in the normal processes, were not adversely affected. The chief interest in the new techniq in regard to alum tanning lies in determining whether infra-red rays tend to speed up the completion of tanning for which, at present, three weeks' storage is usual. Other points raised concerned the possibility of separating ultra-violet from the infra-red rays with a view to avoiding oxidation, and the reduction of the relative humidity in the infra-red cabinets - the relative humidity in the Mazda apparatus described was very high.

393. Hall, E. F. S. A. T. R. A. Technical Memorandum. T.M. 1050. 1950

COMPARISON OF DRYING TIMES AND BOND. Strength of Adhesives, when dried at Room Temperature and when exposed to Infra-Red Radiation.

394. Humphreys, F. E. and Innes, R. F. B. L. M. R. A. Monthly Digest Sept. 1946

THE USE OF INFRA-RED RADIATION FOR DRYING LEATHER. Results for various leathers, after infra-red drying. Goatskins - normal, Chrome tanned side - normal, Sole leather - evidence of heat damage. Basil - Dark patches formed. Split Hides - similar to basil. Conclusions. Infra-red drying might be employed successfully in some cases, but still doubtful as a practical proposition.

395. Seurin, G. Assn. Francaise des Chimistes des Industries des Cuir. Paris 1949. 14 pp.

PRINCIPLES AND APPLICATIONS OF INFRA-RED TECHNIQUE. (Transl.).

396. Anon. L.I.R.I.Mon.Circ., 1946, 6, No. 2, 8. Feb. 1946
PASTE DRYING. Experiments are in progress with various glues and pastes, with a view to enabling heavier leathers to be dried by pasting on to glass or lacquered boards, as practised by many up-to-date overseas concerns. The non-aqueous types of glue, such as mixtures of castor oil and rosin, were not found satisfactory because they appeared to lose their adhesive power in contact with the wet leather. Starch pastes did not have the initial grip required. The best results so far obtained have been with a liquid animal glue, the formula for which can be obtained by subscribers on request. Sept. 1946. Carpenters Glue 20 grams. Glacial Acetic Acid 2 c.c. Water to 100 c.c.

397. ---- L.I.R.I.Mthly.Circular. 6. No. 1, 6. Jan. 1946
MECHANICAL FINISHING. Substitute for glass. Ducoed Plywood gave excellent results. Enamelled plywood was unsatisfactory. Stainless steel, buckled and separated. Polished Aluminium Sheet was satisfactory for a few times only.

398. ---- L.I.R.I. Ann. Rep., 1945, 43. October, 1945
DRYING OF LIGHT LEATHERS BY PASTING. Experiments with masonite or plywood well coated with nitrocellulose lacquer to give a high gloss surface have shown these materials to be equally as good as grass for pasting-drying. The boards are easier to handle and more economical, but require a periodic renewal of the surface. In order to obtain a brighter glaze than is obtained merely by pasting the wet skin, experiments have been made with a number of adhesives. Isinglass, casein, and egg albumin caused the leather to adhere too firmly to the boards. A 2 per cent. mucilage of linseed, brushed over the grain immediately before pasting gave an excellent glaze, provided that the skin was removed from the board before it was absolutely dry in order to avoid damage to the grain. A good marocain can be obtained by boarding the linseed-pasted skin. Attempts to paste heavy leathers have not as yet been successful.

399. Anthony, R. Leather and Shoes 116. 15 and 19. Oct. 1948
GLASS PASTING FOR CRITICAL LEATHER. History, advantages and procedure of paste drying.

400. Argabrite U.S.P. 1,992,138. 1935
PASTE DRYING OF LEATHER. Prevents evaporation from and defects in the grain side of leather.

401. Cox, W. R. and Roddy, W. T. J.A.L.C.A. 43. 561. Sept. 1948. 45. 270-285. May 1950

STUDY OF LEATHER PASTING. I. A study of the factors concerned. A brief history of the progress of paste-drying. American tanner prefer glass plates. 2. Effect of fat content on dry adhesion. Development of test conditions and paste formulae.

402. Gourlay, P. Rev. Tech. Ind. Cuir. 40. 5. Jan. 1948

PASTE DRYING BY THE SPECO. METHOD OF DRYING. A paste drying plant is dear. Process in which plates of enamelled steel or gla are used. Formulae are given for paste to a basis of dextrin, tapioca, starch or potato starch.

403. Silaev, A. N., Balashov, V. S., and Sklovskii, M. M. Leghaya Promyshlennost No. 4. p. 14. 1949

IMPROVED METHOD OF PASTING-DRYING. Describes the use of oil emulsions instead of vegetable glue. Formulae given. See B.L.M.R.A. Monthly Digest, page 164A. October 1949.

404. Woikin, M. Leather & Shoe Industry in U.S.S.R. No. 216. 1935. Collegium No. 842. 262. 1940

PASTE DRYING IN RUSSIA. Wooden Boards are used. The adhesive i composed of 80 grams of Potato Starch, 1 litre of water, 21 grams carpenters glue in 1 litre of water, mixed. Time to dry is 15 hours at 28-30°C.

405. Woodhead, T. L.I.R.I. Monthly Circular 6. No. 1-6. June 1946

PASTE DRYING OF LIGHT LEATHERS. Perspex has been tried. Excell results. One firm dried 700 skins daily for 2 years. With Plat glass breakages are small.

Physics And Chemistry

406-7. Various Authors British Leather Manufacturers Research Association.

THE MOISTURE RELATIONS OF GELATIN. A considerable amount of investigation has been carried out by the R.A. and recorded in various periodicals. See under GELATIN AND GLUE.

408. Anon. J. Int. Soc. Leath. Trade Chem. 13 (1929) p. 10, p. 87
VAPOR DIFFUSION AND WATER ABSORPTION. Data on 1. Eq. Water Content. 2. Water Vapor Diffusion Through. 3. Liquid Absorption by Various Leathers. Use Fourier Integrals of Diffusion Equation.

409. ---- Progress in Leather Science. 1920 to 1945
B.L.M.R.A. 1948. Chapter 14. The physical properties of leather. Chapter 15. The permeability of leather to air, water vapour, and liquid water. Chapter 17. The effects of heat and moisture on leather. Chapter 29. The drying of leather.

410. Beakbane, M. E. and Robinson, C. .L.M.R.A. Laboratory Reports
THE CONTACT ANGLES OF WATER AGAINST LEATHER. AUTHORS' SYNOPSIS. A simple method of obtaining approximate values for the advancing and receding angles made by water against the surface is described. The significance of these contact angles, which are an indirect measure of the attraction of the leather surface for water, is discussed. Both the advancing and receding contact angles which are obtained are often very much higher than they would be for the single leather fibre. This is due to the very great influence of structure on the contact angle of a porous system, as has been explained by Cassie and his co-workers in the case of textiles. The receding contact angles in some cases change very rapidly with time, as the result of films of water replacing the air in the structure. The penetration pressure is determined by the advancing contact angle, but the receding contact angle is also shown to be of great importance in determining the water resistance of leather. It is suggested that the measurement of receding contact angles might be of value as a supplementary observation in assessing water resistance. It is, however, possible to obtain considerable information from the behaviour of a drop on a tilted leather surface. It has been shown how receding contact angles may be influenced by aluminium soaps, even where there is little change in the advancing contact angles.

411. Bell, K. E. J. Amer. L. C. A. 36. 642-9. 1941
DRYING OF LEATHER. Relations between R.H. and Moisture Content, and between time in driers v.s. water removed.

412. Bowes, J. H. and Morse, G. O. Br. Leather Mnfrs. R. A. Suppl. Rept. 3. 1. 1942. J. Soc. Leather Trades Chemists. 32. 343. 1948
THE USE OF SALTS IN THE FINISHING OF SOLE BENDS. Pt. 3. The effect of Magnesium Sulphate, Cane Sugar, and Glucose on the Drying of Leather and on the moisture content of leathers at different R.H.s. These materials cause a reduction of the amount of water lost in drying, and absorption of moisture at high R.H.

413. Bradley, H. J.Soc.Leather Trade Chemists 14.516.1930
SOME PHYSICAL PROPERTIES OF LEATHER. The most important physical property of leather is that which is represented by the sorption isotherm. Results of experimental work on sorption, and reference to air permeability.

414. Bradley, H., J.I.S.L.T.C.Feb.1929
McKay, A. T., and
Worswick, B.
MOISTURE IN LEATHER. Introduction - Significance of Moisture - General summary of behaviour of leather in relation to moisture. REVIEW OF LITERATURE (See attached Bibliography). Own Experimental work:- Equilibrium Moisture Content. Moisture movement and transmission. Absorption of liquid moisture. Diffusion Constants, and Mathematical Discussion. This is an attempt to put results of experimental work on a theoretical basis and to derive constants from experimental data.
Bibliography:-
1. Orme, Masson and Richards. Proc.Roy.Soc.78A. 412.1907.
2. Trouton and Poole. Proc.Roy.Soc.77A. 292.1906.
3. Forest Prod. Res.Lab.Tech.Papers 1 and 2.
4. Veitch and Jarrell. J.A.L.C.A. 16.10.1921. 19.10.1924. 20.7.1925. A.L.C.A. Cttee. Report. J.A.L.C.A. 22.6.1927.
5. Rudeloff. Mitteilung Ktg.Mat.Pruf.Amt.Gross-Lichterfelde 1904. 11.1-2.
6. Merrill and Banake. J.I.S.L.T.C. 11.10.1927.356.
7. Wilson and Kern. J.A.L.C.A.21.7.1926.
8. " " " " " 5. "
9. Coc.cit.5.(Rudeloff) and Reisnek.Collegium 1925.167-8.
10. Veitch, Frey and Leinbach. J.A.L.C.A. 17.10.1922.
11. Wilson and Kern. Ind.Eng.Chem. 19.115.1927.
12. Wilson and Lines. J.I.S.L.T.C. 9.6.1925.
13. Gordon Parker. Tanners Year Book 1908.
14. E. Nihoul. Collegium (London) pp.147-50. 1916.J.S.C.I.35. 748.
    Woodroffe and Morgan, J.S.L.T.C. Nor.1922.
15. Reisnek. Sch.Led.Ind.Zeit.41.1925.
    J.A.L.C.A.21.5.1926. Chem.Abstr.19.2758.1925.

Bradley Comments "Greater proportion of these papers 1-15 consist merely of records of behaviour. No evidence of any attempt having been made to interpret the behaviour in terms of general physical theories which would lead to the detn. of constants or coeffs. for the specimens tested."

415. Bradley, H. J.I.S.L.T.C.p.121-128.March 1934
THE DRYING AND WETTING OF LEATHER. Emphasises importance of controlled methods of humidification and drying in shoe factories. Diffusion Equations quoted. Movement of water from warm to cool area. Br.Boot and Shoe R.A.Pamphlet. March 1934.

416. Brandis, J. E., Br. Leather Mnfrs. R. A., Lab. Rep. Aug. 1947
Hall, R. H.
Mitton, R. G.
THE WATER ABSORPTION OF VEGETABLE TANNED SOLE LEATHERS.

417. Brown, W. B. Br. Leather Mnfrs. R. A., 17. 43. 1937. 1938.
Holmes, N. L. D. S. I. R. 88. g/26 and 27
THE SPECIFIC PROPERTIES OF TANNING MATERIALS. 1 AND 2. Includes the volume relations of wet tanned leather.

418. Conabere, G. O. Br. Leather Mnfrs. R. A., Lab. Report. May 1945
Hall, R. H.
THE EFFECT OF ATMOSPHERIC HUMIDITY ON THE STRENGTH AND STRETCH OF GLAZED KID. Change in physical properties were examined at various R.H. and at different sampling positions.

419. Conabere, G. O. Br. Leather Mnfrs. Res. Assn. Lab. Rept. 23. 1944
Robertson, M. E.
HEAT DAMAGE TO LEATHER. Part 1. Changes in Microstructure produced by drying soaked vegetable-tanned sole and chrome-tanned side upper leather at raised temperatures.

420. Cushnie, H. C. Br. Boot, Shoe and A. T. R. A. Res. Rep. R. R. 68. 1942
THE TRANSMISSION OF HEAT, MOISTURE AND AIR THROUGH UPPER LEATHER. Results of experimental work in relation to foot comfort.

421. Edwards, R. S. Br. Boot, Shoe and Allied Trades R. A. Report No. 30. 1930
MOISTURE IN LEATHER. ABSORPTION AND DRYING OUT. Results of experimental work; suggested conditions of storage to prevent deleterious effects.

422. Edwards, R. S. J. I. S. L. T. C. XIV. 392-410. 1930
THE AIR PERMEABILITY OF LEATHER. Review of the literature: experimental methods, comparison of results and theoretical aspects.

423. Edwards, R. S. Br. Boot, Shoe and Allied Trades R. A., Rep. No. 40. J. S. L. T. C. 15. 495. 1931
THE WATER PERMEABILITY OF LEATHER. Experimental work on the conditions affecting penetration of water in leather.

424. Edwards, R. S. J. I. S. L. T. C. 16. pp. 439-448. Sept. 1932. Br. Boot and Shoe and A. T. R. A. No. 40
THE TRANSMISSION OF WATER VAPOUR THROUGH LEATHER. The effective radii of the minor moisture holding capillaries are of the order of 10^{-7} cm. Radii of the major air and vapour transmitting capillaries are estimated from the formula to be of the order of 10^{-4} cm., while there are in effect 10^{-6} such capillaries per cm.^{2} of the leather. See Bradley's paper, Br. Boot and Shoe R. A. No. 43/1934.

425. Edwards, R. S. J.I.S.L.T.C.XVII.402-413.1933
Brown, G.
THE THERMAL CONDUCTIVITY OF BOOT AND SHOE MATERIALS. Description of apparatus and results. Movement of Moisture from warm plate to cold plate of the apparatus.

426. Hall, R. H. J.S.L.T.C.32.331.Oct.1948.B.L.M.R.A.Lab.
Mitton, R. G. Repts.26.1947
WATER ABSORPTION OF VEGETABLE-TANNED SOLE LEATHERS.

427. Holland, H. C. J.I.S.L.T.C.27.p.207-214.1943
THE EFFECT OF TANNAGE ON MOISTURE CONTENT OF LEATHER. PART I. Curves of equilibrium. moisture contents v.s. tannage content. Analysis tables for various tanning materials. Conditioning at 55% R.H. at 25°C.

428. Holland, H. C., J.I.S.L.T.C.29.p.79-85.1945
Woolston Tanneries,
New Zealand.
THE EFFECT OF TANNAGE ON MOISTURE CONTENT OF LEATHER, PART II. Moisture Contents of Tanned v.s. Untanned Leather.

429. Holmes, N. L. Br.Leather Mnfrs.R.A.Lab.Report 15.1.1936
Brown, W. B.
AN INVESTIGATION INTO THE HYGROSCOPIC PROPERTIES OF TANNING MATERIALS
Of the eight extracts examined quebracho and mimosa shewed least variation of water content with atmospheric humidity. It appears that the moisture content of a leather depends on the kind of water soluble material present as well as on the quantity.

430. Humphreys, F. E. Br.Leather Mnfrs.R.A.Lab.Rep.15(1).Aug. 1936.D.S.I.R. R.R.55.f/d.
THE DRYING OF VEGETABLE TANNED SOLE LEATHER. PART I. THE EFFECT OF VARYING THE RELATIVE HUMIDITY AT CONSTANT TEMPERATURE AND AIR FLOW

431. Humphreys, F. E. Br.Leather Mnfrs.R.A.Lab.Rep.1937.Pt.3. 373.J.I.S.L.C.22.224.1938
SOME NOTES ON THE CONTROL OF HUMIDITY AND THE CONSTRUCTION OF A CONSTANT TEMPERATURE AND HUMIDITY CABINET FOR LABORATORY USE.

432. Humphreys, F. E. Br.Leather.Mnfrs.R.A.Lab.Report.17(2).210 1938 and 19(2)157.1940
THE COMBINED EFFECT OF HEAT AND MOISTURE ON LEATHER. The drying of soaked leathers at constant temperature above 100°F. was very harmful The effects of heat and moisture depend on the method of tannage. Parts 1, 2 and 3 deal with the effects on various leathers and the work extends from 1938 to 1940. Drying leathers above 50°F. is likely to cause deterioration.

433. Humphreys, F. E. Br.Leather Mnfrs.R.A.Lab.Report 19(1) 16.
1940.D.S.I.R. R.R.55.f/d

THE DRYING OF VEGETABLE TANNED SOLE LEATHER. PART II. THE EFFECT OF VARYING THE SPEED OF AIR FLOW AT CONSTANT TEMPERATURE AND HUMIDITY.

434. Humphreys, F. E. Progress in Leather Science 1920-1945.
Br.Leather Mnfrs.Research Association.
Chapter 29.pp.625-637

DRYING OF LEATHER. 1. Theoretical Considerations. 2. Effect of atmospheric conditions on the drying of leather. Moisture relations of leather and curves to illustrate. 3. Effect of predrying treatment. 4. Practical control and design of drying sheds. 61 Refs.

435. Humphreys, F. E. Br.Leather Mfrs.R.A.Lab.Rep.March 1951
D.S.I.R.5948/b

THE DRYING OF COLLAGEN AND ITS REABSORPTION OF WATER FROM HUMID ATMOSPHERES.

436. Innes, R. F. J.S.L.T.C.15.126.1931.B.L.M.R.A.Report

THE DETERMINATION OF WATER IN LEATHER. Oven methods give uncertain results. Volatile matter other than water may be released.

437. Innes, R. F. Br.Leather Mnfrs.R.A.Lab.Rep.15.1.1936.
J.Soc.L.Tr.Chem.21.25.1937

THE ABSORPTION OF MOISTURE BY CERTAIN SALTS AND BY GLUCOSE, WHEN STORED IN ATMOSPHERES OF VARYING R.H. Indicates the suitability of certain salts for different climates.

438. Kanagy, J. R. J.Amer.L.Chem.Assn.45.211-42.1950.Chem.
Vickers, R. A. Abstr.44.8145.1950

FACTORS AFFECTING THE WATER VAPOUR PERMEABILITY OF LEATHER. Data are presented, derived from the A.L.C.A. method of measuring permeability for various types of leather. Above 20% R.H., permeability shewed a marked increase, indicating that pure gaseous diffusion was not the complete mechanism of transfer.

439. McLachlan, N. W., Br.Boot and Shoe and A.T.R.A.Res.Rep.
Lewis, T. R. G. R.R.64.J.I.S.L.T.C.25.76.1941
Goodfellow, H.

EVAPORATION OF WATER FROM SHOES. The rate of evaporation was found to depend upon the kind of leather. Apparatus and results of tests are described.

440. McLaughlin and Theis Reinhold.New York.1945

CHEMISTRY OF LEATHER MANUFACTURE.

441. Marshall, F. F. J.A.L.C.A., 1946, 41, 6. January, 1946
Williams, D.
PERMEABILITY OF LEATHER TO WATER VAPOUR. A box was built of 10-iron vegetable-tanned sole leather of a size to house conveniently a Friez humidistat, a window being fitted to allow the hygrometer to be read from without, and precautions being taken to prevent the transmission of water vapour at the leather junctions. An external humidistat was placed by the enclosed one and checked frequently with a sling psychrometer. With this apparatus the authors set out to determine the effect of different temperature and/or relative humidity, existing simultaneously at the two surfaces, on the flow of water vapour through a leather.

442. Merry, E. W. Br.Leather Mnfrs.R.A.Lab.Res.Rep. 15. 1.
1936. Strasing Festschr. 251. 1937
FACTORS WHICH AFFECT THE ABSORPTION OF WATER BY NEW AND WORN SOLE LEATHER.

443. Mitton, R. G. J.I.S.L.T.C. 29. 169. 1945
MECHANICAL PROPERTIES OF LEATHER FIBRES. Para. on "The regain of leather fibres." Curves of regain v.s. R.H. Para. on "Dependence of fibre length on Humidity." Curve of Extension v.s. Humidity.

444. Mitton, R. G. J.Inst.Leather Chemists 30. 330-333. 1946
THE ABSORPTION OF WATER VAPOUR BY CHROME TANNED LEATHER. Curves of Regain v.s. R.H. Bound fibres retain more moisture than fibres free from mechanical restraints. M. content decreased with amount of Veg. Tannage. M. content remained approximately constant with varying amounts of chrome tannage.

445. Mitton, R. G. Br.Leather Mnfrs.Res.Assn.Report Sept.194
THE MEASUREMENT OF WATER PENETRATION THROUGH LIGHT LEATHERS AND A COMPARISON OF STATIC AND DYNAMIC METHODS. Expts. on the amount of flexing and water penetration. The number of flexes can be predicted from a knowledge of penetration pressure, thickness and density of the leather. Flexing can afford comparisons, but to assess water-proofing treatments, a measurement of penetration pressure is better.

446. Mitton, R. G. J.Soc.Leather Trades Chemists 34. 41-57
1950
THE EFFECTS OF HUMIDITY ON THE AIR PERMEABILITY OF LEATHER. (Permeability increases with pressure and decreases with increasing R.H.)

447. Moore, J. W., J.I.S.L.T.C. 24. 265-271. 1940
Vilbrandt, F. C.
Polytechnic Inst.Virginia
DRYING OF FIBROUS MATERIAL - VEGETABLE TANNED LEATHER. Tables of moisture relationships for heavy veg. tanned leather.

Recommendations for conditions of drying 94% R.H. for 3 days to 60% R.H. for 4 days. Air Velocity 125 - 225 ft./min. T.=69°F. at beginning to 77°F. at end. Optimum time of drying = 7 days. Humidity control is the most important factor.

448. Phillips, H. Br.Leather Mnfrs.Research Assn.1950.22pp.
Directors Annual Address, 1949.Nov.
WHY LEATHER FOR FOOTWEAR AND CLOTHING. An exposition of the physical characteristics of leather as a fibrous material, its moisture relations and its permeability. The particular advantages conferred by these characteristics are described. Diagrams, tables and curves are given.

449. Rice, G. R. Br.Leather Mnfrs.R.A.Rep.1950
APPARATUS FOR THE MEASUREMENT OF WATER-VAPOUR PERMEABILITY OF LEATHER. The "barrier" method is used, with two atmospheres of high and low humidity, and removal of stagnant air by a high speed fan and a solid desiccant in constant motion. B.L.M.R.A.Abstr.D.S.I.R./4133/b.

450. Robinson, C. Br.Leather Mnfrs.Res.Assn.Lab.Reports 23
Topp, N. E. 1944
Permeability of Leather. Part III. The diffusion of Water Vapour through leather. Method:- The rate of evaporation of water from the surface of a gel covered with leather is compared with that of the uncovered surface. Relation of pressure to foot comfort is discussed. Leather is very permeable to water vapour but resistant to liquid water.

451. Robinson, C., Topp, N. E. Discussions Faraday Soc.No.3.273-282.1948
Beakbane, M. E.
THE PENETRATION OF LEATHER BY WATER AND WATER VAPOUR. For maximum water resistance, leather must have a high, penetration pressure (small capillary radius and high advancing contact angle) and a high receding contact angle. A method which makes it possible to express measurements of water vapour permeability in absolute units as diffusion co-efficients is given. Measurements of penetration pressure, rates of flow, and contact angle give a good indication of how the leather will behave as regards water resistance.

452. Roddy, W. T. J.A.L.C.A., 1947, 42, 190. April, 1947
O'Flaherty, F.
SOME NOTES ON THE AIR PERMEABILITY OF HEAVY LEATHER. The Maeser air permeability apparatus for light leather was found suitable for heavy leathers, using a large specimen holder and a pressure of 2 in. of mercury. Results showed permeability of leather to air was greater when the air passed from flesh side to grain side, when the leather was previously flexed, and when it was soaked and re-dried. Repeated soaking and drying increased porosity as the water-solubles content was decreased.

453. Statner, F. Herfeld, H. Gesammelte Abh.dtsch.Lederinst.No.4.84 1950.B.L.M.R.A.Monthly Digest 8.No.8. Aug.1950

EFFECT OF DRYING AND MECHANICAL FINISHING ON THE PROPERTIES OF LEATHER. The influence of temperature at constant R.H. on the drying of heavy stuffed leather.

454. Wilson, J. A. Lines, G. O. Ind.Eng.Chem.17.570-3.1925

THE VENTILATING PROPERTIES OF LEATHER. Two factors influence comfort of shoes, porosity and permeability. The differing values depend largely on the oil and finishing material applied. Methods for measuring these factors are developed.

Tanning Materials

455. Anon. Bull.Assoc.franc.chim.inds.cuir.II. 160-2(1949)

ULTRA-RAPID DRYING. An apparatus is described for drying analytical tan liquor-solutions rapidly at 100°C in a current of dry air. Completion of drying is detected by colour change in cobalt test paper.

456. Sievers, A. F. Clarke, I. D. J.Amer.Leather Chemists Assn.44.573-96. 1949.Chem.Abstr.43.9507.1949

METHODS OF DRYING SUMACH. Laboratory and large scale experiments are described on the effect of various drying methods on the tannin contents and tanning characteristics of dwarf, staghorn, and white sumacs.

457. Slade, F. H. Chemical Products 13(5)184.April 1950

SPRAY DRYING DEVELOPMENTS. Tanning Extract is concd. to 52% solid in a triple effect climbing film evaporator and spray dried.

TIMBER

Equipment

458. Anon. Mech.Eng.45 110.1923
A good description of various types of lumber dryers. Operating data are given.

459. —— B.I.O.S. Reports Nos. 479 and 529.
WOOD SAWING AND KILN EQUIPMENT. Drying Equipment for Plywood. Germany

460. —— Escher-Wyss. Zurich. Pamphlet:
Esher-Wyss. Heat Pumps. Use in drying timber.

461. Anon. Gas Wld. 17 Feb. 1945, 122 Indust. Gas 22.
WOOD DRYING BY GAS. Description and diagram of an oven designed by the Ascot District Gas and Electricity Co. for the drying of timber.

462. Anon. Genie Civil, 1 May, 1944, 121 74
"VENTIL" AND "MASSAUX" APPARATUS FOR DRYING WOOD FOR PRODUCERS. Two wood drying ovens are briefly described, each consisting of a hearth for burning sawdust or wood shavings, and a drying chamber through which the hot gases pass. Means for regulating air flow etc. are provided. The first is intermittent and the second continuous.

463. LUMBER KILNS, MISC. E. N. Angus, Wood-Worker 51 n 8. Oct. 1932 p.21.
W. K. Loughborough, Furniture Mfr. V. 44 n 4 Oct. 1932 p.43.
H. L. Henderson, Wood-Working Industries 11, No. 2 Feb. 1932, p.18.

464. Antoni, A. Genie Civil v 101 n 25 and 26 Dec. 17
1932 p. 597-602 and Dec. 24 p. 626-8.
LE SECHAGE INDUSTRIEL DES BOIS. Features of French open circuit driers with forced draft, also closed circuit water injection driers; drying of plywood; live steam driers; chemical action driers; duration of drying process; drying curves. (Concluded)

465. Boer, L. J. J. Electrotechniek, 23 Oct. 1947, 25, 334-338
WOOD DRYING IN FURNITURE MANUFACTURE. A drying chamber heated by electric resistor elements is described having a timber capacity of 12m.3, with automatic temperature-controlled circulating system. Photographic illustrations of equipment and electrical circuit are shown. E.R.A.

466. Burns, A.F., Hyde, W.S. Industr. Gas. 27 (13) 25-26 Aug. 1948
GAS FIRED LUMBER DRYING KILNS. A description of a natural draught and a forced draught lumber drying kiln is given.

467. Risser, R. A. Industr. Gas, Feb. 1948, 26, 19-20, 30-31
USE OF NATURAL GAS IN KILN DRYING OF LUMBER. After briefly summarizing the fundamentals of lumber drying to illustrate the requirements which must be met by a gas heating system in a drying kiln, the author describes three types of gas heating systems now in use. The chief factor which has slowed down the general acceptance of gas kilns has been the unwise design of many of them, leading to unsatisfactory drying and loss through fires.

468. Smith, H. H. U.S. Dept. Agric. For. Prod. Lab. Rep. R. 1474. 11pp. 1945
FURNACE TYPE LUMBER DRYING KILN. Operation of An Experimental Unit

469. Stevens, W. C., Harris, P., Pratt, G. H. Wood. 4pp. 9/1944
FURNACE HEATED TIMBER DRYING KILN.

Process. General

470. —— U.S. Office of Naval Research 537p. Photographs, graphs tables Oct. 1949.
Wood. Report of Symposium
1. Wood - Research.
2. U.S. Nat. Res. Council.
3. N.R.C. - O.N.R. Symposium on wood 1949.

471. Anon. Commonwealth Engr. 23 No.7 Feb. 1 1936 p. 209-12
MODERN TIMBER SEASONING KILN. Development by Commonwealth Council for Scientific and Industrial Research; longitudinal shaft kilns; cross shaft kilns; Australian installations; construction and operation.

472. Anon. Engineering 143 No. 3717 Apr. 9 1937 p. 408
TIMBER DRYING. Review of report published by Department of Scientific and Industrial Research, Forest Products Research Records No. 13, published by H.M. Stationery Office, London, price 6d. net.

473. —— For. Prod. Res. Laby. Leaflet No. 44 April 19
THE SEASONING PROPERTIES OF EXOTIC TIMBERS. Part 1. Shrinkage and movement on drying of twelve exotic timbers.

474. —— Forest Products Res. Laby. Tech. Note No. 2 1948 p. 4. D.S.I.R. records M. 11.
APPROXIMATE AIR SEASONING AND KILN DRYING PERIODS FOR INCH LUMBER.

475. Anon. Forest Products Research Laboratory. 1944, Leaflet No. 36, 6pp.
SOME OBSERVATIONS ON TIMBER-DRYING KILNS AND THEIR PROPER USE. Aft a brief discussion of the various types of kiln commonly employed in this country for seasoning wood, their respective merits, and the possibility of converting or modernizing an out-of-date kiln, practi notes intended for the guidance of kiln operators are given on (1) (1) control equipment and the keeping of records, (2) piling timber a kiln, (3) drying times and schedules, and (4) allowance to be made for shrinkage.

476. —— F.I.A.T. Repts. 389 and 479
Drying of Timber in Germany.

477. Many authors. Forest Prod. Res. Laby. and Furniture Tr. Manfg. Orgn. Conference on wood seasoning Asheville N.C. 2-3 Oct. 1947 74 pages. D.S.I.R. Records.
WOOD SEASONING. A number of papers and some good discussion on the essentially practical aspects of wood seasoning. Very little drying data. The practical faults in seasoning are fully dealt with. The Hot Oil Drying and the Vapour drying processes are given.
Oil. Wood immersed in oil at 235-260°F and water passes away. Constant temperature is necessary to prevent absorption of oil. Green lumber, 4 x 4, dried to 7-10% m. in 6-7 hours. The case-hardening that occurs can be relieved by a high humidity treatment in a dry kiln.
Vapour passed into a retort containing the wood, water is vaporised, the two vapours are condensed and separated outside the retort and the org. liquid returned to the boiler. 7" x 9" oak ties were reduced from 75% to 35% m. in 12 hours and 2 hours more under vacuum to remove oil, down to 30%. Oil penetration prior to vacuum is 6-8 lbs. per c.ft., but after vacuum to 0.5 lbs. per c.ft. For lumber, an oil boiling at 320°F reduces m. to 4% in 5½ hours with oil penetration of less than 1%. Hardwoods are liable to collapse under this treatment.

478. —— Revue Universal des Mines 86 5,188-193 1943
DRYING OF TIMBER.

479. —— Communicated. 1949
Small scale experiments are very little guide as to the drying of timber in bulk. Large timber may collapse, distort or explode. Kiln drying and air drying are the only safe methods, and are based on experience, trial and error. Certain woods can collapse even on air-drying e.g. (Hiariballi), although small sections may not do it. H.F. drying is being tried out at For. Prod. Res. Lab. Some woods give success, others not, e.g. oak, which explodes owing to pressure set up (to 3 atm). The method is expensive and only applicable to special uses; probably no great future for H.F. drying. Difficult to attain uniformity. Splitting. If the outside gets too dry (too steep a moisture gradient) the wood will split and distort. Temperature gradient does not much matter (below 100°C of course). Chemical treatment, e.g. Urea impregnation to keep outer layers moist. Snag. Oak was soaked in hot sat. urea-water solution. After (some weeks) the centre had lost its water sufficiently to crack and channel while the outside was apparently sound. The penetration of urea solutions is uncertain and cannot be controlled. Infra red. removes water from the outside first and therefore promotes cracking: Moist hot air, has been tried to prevent cracking.

Hot water treatment, then vacuum. Wood is made hot, some moistur comes out, but calculation shews that the heat retained by wood is not sufficient for evaporation of more than a small proportion of water. Australian journal warns against vacuum drying.

480. Forest Products Laboratory — U.S.Dept.Agr.Reports R.1665 to R.1667 1947-8
DEALS WITH METHODS. Boiling in oil, use of superheated steam, vacuum drying, chemical seasoning and dielectric heating, vapour drying, infra-red drying. Only solvent seasoning, vapour drying and chemical seasoning appear to be feasible ordinarily.

481. Bateson, R. G. — Crosby Lockwood & Sons Ltd.1946.
TIMBER DRYING AND THE BEHAVIOUR OF SEASONED TIMBER IN USE.

482. Brown, C. O. — Ind.Eng.Chem.41(3)93A.Mar.1949
EQUIPMENT AND DESIGN. Mentions Tiemann Kiln. Heat material to high temperature without loss of water, then remove water at this temperature. Heat removed from centre first and therefore no cas hardening occurs. (The method is applicable to some other materia that case-harden).

483. Cohen — Verkehrstechnik(Berlin),No.30,July 25, 1930,pp.389-396
NATURAL AND ARTIFICIAL LUMBER DRYING (NATUERLICHE UND KUENSTLICHE HOLZTROCKNUNG). Comparative discussion of natural and artificial drying of lumber; systems of lumber drying kilns; rules for artificial drying; hot steam as drying medium; chart for lumber drying operations; design of drying kilns of railroad shops of Frankfort on Main; economics of artificial drying, cost data. 7 fig

484. Duffs, J. S. — 49,p.30-31.1930 Wood Worker.
THE ESSENTIALS OF KILN DRYING.

485. Egner, K. — Chemiker-Ztg.60 No.69 Aug.26 1936 p.703-4.
AUS DEN HEUTIGEN ERKENNTNISSEN UEBER HOLZVERGUETUNG. Review of present knowledge concerning improvement of mechanical properties of wood, by prevention of swelling and shrinkage under influence of fluctuating humidity; improvement of workability; and means of obtaining better and more uniform strength properties; notes on artificial drying of wood; moisture resistant paints; impregnatio of wood, etc.

486. Eisenmann, E. — Holz-Zentralblatt 1950.No.47.D.S.I.R/ 6231/CT
THE PRESENT POSITION OF THE HOT STEAM DRYING OF WOOD, AND ITS ECONOMIES. (Transl.title.)

487. Graham, P. H. Woodworker.59.9.56.9.11.1950
HUMIDITY IN THE FACTORY. Emphasis is laid on the importance of maintaining reasonably constant humidity in machining and assembly shops.

488. Henderson, H. L. Wood Working Industries,9,No.1 Jan.1931, pp.28-29 and 37,4 figs.
MEASURING MOISTURE IN LUMBER. Careful testing during kiln drying assures properly seasoned stock; sample board method recommended.

489. Henderson, H. L. J.B.Lyon & Co.Amer.1936 London Agents. A.Harvey
AIR SEASONING AND KILN DRYING OF WOOD.

490. Huber, J. Bauwelt,1947,21,413-416.
DRYING OF WOOD (FOR WOOD-GAS PRODUCERS). Methods for the preliminary drying of wood so as to increase the efficiency of the process for the production of wood gas are discussed.

491. Hyler, J. E. Mill and Factory Illustrated,8,No.3, Mar.1931,pp.55 and 57,1 fig.
KILN DOOR HAS INSULATING VALUE OF 13-inch WALL. Increased efficiency of modern doors.

492. Japing, H. W. Forest Res.Stn.Indonesia.Pamphlet No.3 1949.
THE OVEN DRYING OF TIMBER. Advantages, disadvantages. Applications. Oven types, etc. (D.S.I.R.3747/C.T.)

493. Kohler, A., Thelen, R. McGraw-Hill N.Y.1926
KILN DRYING OF LUMBER.

494. Kollmann, F. Forschung auf dem gebiete des Ingenieurwesens 6.4 July/Aug.1935 p.169-74
RECHNERISCHE VERFOLGUNG DER KUENSTLICHEN HOLZTROCKNUNG. Calculation of kiln drying of lumber; review of previous researches; drying as problems of diffusion; equations for calculating drying time; influence of unit weight and structure, of thickness, moisture content, temperature, relative moisture of drying air, quality of drying chamber, etc.

495. Kollmann, F. Archiv fuer Waermewirtschaft 16.12 Dec.1935 p.329-35.
DER WAERMEVERBRAUCH BEI DER KUENSTLICHEN HOLZTROCKNUNG. Heat requirement for artificial drying of wood; calculation of heat consumption of plant under different operating requirements, indicating possible means of fuel economy.

496. Koritnig, O. T. Giesserei 22 No.10 May 10 1935 p.222-5
DAS DAEMPFEN UND TROCKNEN VON HOLZ IN MODELLTISCHLEREIEN. Steamin
and drying of wood in pattern shops; description of method and equi
ment employed.

497. Koyl, E. F. Wood-Worker 55 No.2 April 1936 p.26-8.
MODERNIZING LUMBER DRYING METHODS. Periodical testing of kiln charge for moisture content (M.C.) of stock; various methods of kiln-drying of lumber.

498. Lofgren, B. E., Sahlman, E. J. Finn.Paper and Timber J.32.B. Special No.4a 51-56 57-58.1950.
TRANSVERSE OR LONGITUDINAL TIMBER DRYING KILN. After a discussion
the factors involved, it is concluded that if space is available th
longitudinal kiln for drying sawn timber is cheaper and more suitab
It is concluded that the two types are fairly equal and that the choice is governed by the transportation problems of the mill site.
B.II.1234 Dec.1950.

499. Loughborough, W. K. Madison, Wisconsin. (Forest Products Lab. No.R.1647.1947.
ECONOMICAL AND EFFICIENT KILN OPERATION, FOR WOOD SEASONING".
(D.S.I.R. Library)

500. Milligan, W. C. Wood-Worker, 49, No.9, Nov.1930 pp.14-17 42-43.
THE LUMBER DRYING SCHEDULE. As different kinds of lumber require different methods of treatment in kiln-drying, schedule of procedur
for each kind used is necessary to insure that lumber will come fro
kiln in proper working condition.

501. Moll, F. Z.Ver.deut.Ing.74 343-4 (1930)
ON THE ARTIFICIAL DRYING OF WOOD.

502. Oakleaf, H. B. Timberman, 32, No.7, May 1931 pp.32-33, 2 figs.
KILN DRYING COMMON LUMBER IN YARD. New system for seasoning lumbe
in pile requiring no investment in dry kiln buildings; table of cool air drying of fir, cedar and hemlock lumber.

503. Peterson, R. B. F.I.A.T.Rept.No.409.
GERMAN LOGGING LUMBER ETC. INDUSTRY. P.23. Limited use of drying
kilns. Benno Schilde Machinbau, Hersfold produces all types inclu
redryers for veneer, wallboard etc. 5 Illustrations of large Walzenbahntrockner. 20 metres long with 5 shelves. P.25 Electronic drying is of academic interest only.

504. Pfister, E. Wasser- u Energiewirtschaft 28 No.7-8 July-Aug.1936(Supp)p.45-8
ELECTRISCHE HOLZTROCKNUNG. Review of modern electric processes of wood drying; example of Swiss electric wood drying plant.

505. Pfister, E. Rivista Tecnica della Svizzera Italiana 26/6. June 1937 p.82-6.
ESSICAZIONE ELETTRICA DEL LEGNO. Electric processes of wood drying. Translation of article previously indexed from Wasser- u Energiewirtschaft July-Aug.1936.

506. Pallas, E. Waerme 58 No.22 June 1 1935 p.356-8
BESTIMMUNG DES WAERMEAUFWANDES BEI DER KUENSTLICHEN HOLZTROCKNUNG. Determination of heat requirements with artificial drying of wood; analysis of different factors governing design of wood drying plants; examples given.

507. Rasmussen, E. F. Madison Wisconsin.For.Prod.Lab.
No. R.1645 1947. Analysis of problems relating to kiln control.
No. R.1661 1947. Types of lumber dry kilns.
No. R.1664 1947. Kiln tune-ups to correct non-uniform kiln drying conditions. (D.S.I.R. Library).

508. Razous, P. Genie Civil 102,446-9,446-70(1933).
THEORETICAL AND PRACTICAL CONSIDERATIONS ON THE DRYING OF WOODS AND OTHER PRODUCTS. Various types of dryers are described, and formulae given for calculating the volume of air needed, amount of heat necessary for evaporation, and the time required for drying. Some water should be added with the air, at first, to avoid too great a difference between the humidity of the surface and the interior. Convection, ventilation, and the drying of miscellaneous materials (e.g. woodpulp, skins, leather, hair, wool, cloth, starches, malt, etc.) are discussed.

509. Risser, R. A. Industr.Gas,Feb.1948,26,19-20,30-31
USE OF NATURAL GAS IN KILN DRYING OF LUMBER. After briefly summarizing the fundamentals of lumber drying to illustrate the requirements which must be met by a gas heating system in a drying kiln, the author describes three types of gas heating systems now in use. The chief factor which has slowed down the general acceptance of gas kilns has been the unwise design of many of them, leading to unsatisfactory drying and loss through fires.

510. Stevens, W. C. Timber News 56(2113)413.416.1948 F.P.R.B. Reprint 466
THE SEASONING OF TIMBER FOR HIGH CLASS JOINERY IN PUBLIC BUILDINGS. The author discusses the necessity for seasoning building timber to a moisture content of about 12%, which is midway between the probable summer and winter moisture content in a vertically heated building.

The advantages of kiln drying are mentioned and it is emphasised that the building must be thoroughly dry before the timber is installed. D.S.I.R./3110/C

511. Stevens, W. C. Forest Prod.Res.Lab.D.S.I.R.Library 4665/B.1950
DETAILED REPORTS OF VISITS MADE TO RESEARCH LABORATORIES AND TIMBE FIRMS IN U.S.A. AND CANADA FROM SEPTEMBER 20 TO DECEMBER 20, 1949. (D.S.I.R./4665/B).

512. Stevens, W. C. Inst.of Fuel Drying Study March,1951
TIMBER DRYING. The object in drying is to avoid stresses which might cause splitting and while maintaining as steep a temperature gradient as possible. This is done by an air-interchange ventila tion with steam injection. Most of the air within the dryer is recirculated. Reference is made to the timber seasoning schedule determined by the Forest Products Research Laboratory and to the maintenance work needed on a seasoning kiln in order to avoid deterioration caused by the severe temperature and humidity conditions.

513. Stilwell, S. T. C. Trans.Inst.Chem.Engrs.6.12.1928.6 91-1
Conf.on Drying.
THE SEASONING OR DRYING OF TIMBER. A general account, well illustrated.

514. Swartzbaugh, E. S. South Lumberman 8 32-4 1932
SOME MISCONCEPTIONS ABOUT LUMBER DRYING.

515. Thelen, R. U.S.Dept.Agric.Dept.Bull 1136 1929.
Kiln Drying Handbook.

516. Tiemann, H. D. Lippincott.Philadelphia 1921
THE KILN DRYING OF LUMBER.

517. Tiemann, H. D. South Lumberman.142,52-54,March 15,193
143,63-65,May,15,1931 144 45-8,61-2,19
THE ROLE OF HUMIDITY AND STEAM IN KILN DRYING. Effect of humidity upon the drying medium. The objects and advantages of the steami operation.

518. Tombach, H. Amer.Soc.Mech.Engrs.Paper 50.A.109.195
SPECIAL METHODS OF DRYING WOOD. Unconventional seasoning processe are reviewed. Commercial applicability is assessed and availabl data are compared.

519. Torgeson, O. W. Wood Working Industries 11 No.6 June 1932 p.20-4.

SEASONING DIMENSION STOCK. Factors governing various selections necessary in choosing method best for purpose; air drying compared with kiln drying; flitches compared with dimension stock for drying; piling dimension stock for air seasoning and for kiln drying; end coating; effect of high temperature; recommended schedules.

520. Voigt, H. Z.D.V.I.78,(8)245-7(1934)Feb.24.
Ramspeck, E.
THE MOST EFFICIENT DRYING OF WOOD.

521. Wenzel, W. Schweizerischer Verband fuer die Material-pruefungen der technik—Diskussionsbericht No.30 Dec.1934 p.17-26

SPANNUNGSFREIE HOLZTROCKNUNG. Discussion of kiln drying of lumber.

522. Will, H. Z.D.V.D.I.73:1421-3(1929).

DAS TROCKNEN UND KUNSTLICHE ALTERN DES HOLZES. Drying and Artificial ageing of wood.

523. —— U.S.Forest Products Bull 199.Chem & Met. Eng.29 711(1923)

AIR CIRCULATION IN DRY KILNS.

524. Greenhill, W. L. Australia.Council for Sci. & Indus. Research—J.9 No.3 Aug.1936 p.171-6.

EFFECT OF RATE OF AIR CIRCULATION ON RATE OF DRYING OF TIMBER. Two series of tests carried out to determine effect of rate of air circulation on rate of drying of timber in narrow stacks, i.e. stacks in which question of change of air conditions from one side of stack to other has not to be taken into account. Bibliography.

525. Greenhill, W. L. Council for Sci. & Indus.Research—J 10 No.1 Feb.1937 p.33-44.

LUMBER KILNS.AIR FLOW MEASUREMENT RELATION BETWEEN AIR FLOW AND PRESSURE CHANGE ACROSS STACK OF TIMBER. Experimental study of flow of air through rectangular duct consisting of boards and separating strips, similar to openings through timber stack; relation between static pressure change and air flow using strips of different thickness and boards with surfaces of different degrees of roughness. Bibliography.

526. Anon. Finn.Paper and Timber J.32 B.354-5.1950.B.II.426.Apr.1951.

NEW RAPID TIMBER DRYING KILN. The features of a kiln available in several sizes are described.

527. Henderson, H. L. Wood Working Industr. 11.2.18-21(1933)
NATURAL VS FORCED CIRCULATION IN KILN DRYING OF LUMBER. Comparati
analysis of natural and forced air circulation; operating character
istics of each system and equipment details.

528. Koyl, E. F. Wood-Worker 56 No.2 Apr.1937 p.24 and 2
IMPORTANCE OF CIRCULATION IN KILN-DRYING LUMBER. General commentar
on control of kiln circulation.

529. Loughborough, W. K. Wood Working Industries, 10,No.1,July 1931,pp.17-19 and 38,3 figs.
VENTILATION IN THE DRY KILN. Problem of ventilation in dry kiln;
analytical method showing how weights of air are affected by variou
conditions, such as temperature, relative humidity, and barometric pressure; changes in weight of air affect ventilation in dry kilns of various types; effect of bearing ventilation on circulation in kiln.

Control

530. Gervais, L. Timberman 38 No.5 pt.1 Mar.1937 p.34,36, 38 and 40.
STABILIZING MOISTURE CONTENT IN LUMBER. Outline of author's ideas
attaining uniformity in lumber seasoning; various steps involved i
evolution of Gervais system of seasoning control, installed at plant
of Edward Hines Lumber Co. Hines, Ore; graphic explanation of metho
given.

531. Hermann, A. West Cast Lumberman,57 Nos.11 and 12,Oct
1930,pp.17-81, and Nov.1930,pp.38-39 and
54.
DRY KILN INSTRUMENTS AND THEIR USES. October. Widespread and gro
ing interest in mechanical seasoning of Western Lumber has created
demand for scientific recording and controlling instruments; equipme
for indicating, recording and controlling temperature; use of hygrometers; three classes of recording instruments; vapor-tension
types. November. Spray controller; precautions; measurement of
moisture content; drying ovens; electrical devices.

532. Hyler, J. E. Mill and Factory Illustrated,8 No.2, Feb.1931,pp.55 and 57,2 figs.
LUMBER DRYING IS CONTROLLED AUTOMATICALLY. Brief account of advantages of automatic control.

533. Kimball, K. E. U.S.Dept.Agric.For.Prod.Lab.Rept.R.1659 Aug.1947.
Charts to assist kiln operators are presented.

534. MacMaster, M. Wood Working Industries, 9, No. 2, Feb. 1931, pp. 25-26.
SYSTEMATIC CONTROL OF KILNS. Rate of drying directly controlled by temperature and humidity.

535. Scheffer, T. C. and Torgeson, O. W. Science 110 214-5 26 Aug. 1949
HUMIDIFYING APPARATUS FOR TEST ROOMS. A hygrostat with wood element for experimental work in timber kiln.

536. Smith, H. H. U. S. Dept. Agric. Repts. R. 1651 Aug. 47.
Charts to assist kiln operators are presented.

Vacuum Drying

537. —— B. I. O. S. Report No. 348
VACUUM DRYERS FOR TIMBER. See under Vacuum Drying.

538. Lund, R. Teknisk Ukeblad (Oslo), 77, No. 49, Dec. 4, 1930, pp. 565-566, 2 figs.
DRYING OF WOOD IN HIGH VACUUM (TORKING AV TRE UNDER HOIT VAKUUM). Vacuum pump particularly applicable in drying of wood is described; pump is invented by Swedish engineer, H. Freberf and is single-acting piston pump with loose and movable cylinder cover.

High Frequency Drying

539. —— Forest Products Research Laby. D. S. I. R. Annual Report 1948 23
Experiments continued during the year lead to the conclusion that radiofrequency drying is only practical and economic when applied to dimension stock valuable enough to make speed of drying rather than cost, the main consideration.

540. —— D. S. I. R. Rept. 1948-9 Forest Prod. Res. Laby.
APPARATUS FOR MEASURING THE ELECTRICAL PROPERTIES OF TIMBER.

541. —— F. I. A. T. Reports 409 and 806.
DRYING BY HIGH FREQUENCY HEATING. (See under High Frequency. Sect. 2.)

542. Anon. Woodworking Industries p. 686-690 Oct. 1948
HIGH FREQUENCY WOOD SEASONING. Rapid drying possible under certain conditions. Based on D. G. Millent paper read to Forest Products Research Soc., Ottawa. Plan of kiln, and distribution results.

543. Aptekman, I. B. Torfyanaya Prom. No. 1. Jan. 1951.
DRYING OF WOOD BY HIGH FREQUENCY CURRENTS.

544. Baumgartner, H. Brown Boveri Rev.,Aug.1945,33,204-210.
HIGH FREQUENCY HEATING IN INDUSTRY. Research and applications ar discussed in four sections. The first deals with the vulcanisati of various rubber mixtures, the second with drying of wood and the third with case hardening by the static and feed procedures. The fourth section describes Brown Boveri h.f. generators for industry E.R.A.

545. Chizhunov, A. Elektrichestvo,Sept.1947,No.9,71-72.
H.F. EQUIPMENT FOR THE DRYING OF DIELECTRICS. An industrial instrument has been developed for dielectric heating operating in the frequency range of 8 to 20 M.c/s. Test results are given for application to wood drying, and a comparison is made with steam drying plant. E.R.A.

546. Hearmon, R. F. S. Forest Products.Res.Lab.D.S.I.R./6304/
Burcham, J. N. March 1951.
THE DIELECTRIC PROPERTIES OF WOOD. 1. Preliminary Experiments o Air Dried Wood.

547. Jervis, A. E. L. Electronic Engng.17 624-630 1945.
HIGH FREQUENCY DIELECTRIC HEATING DEVICES. PRINCIPLES AND APPLICATIC The principles are explained with special reference to the product of laminated boards. Typical curves of time/temperature distribu temperature rise/power, power factor/moisture content, and dielect constant/moisture content, for spruce and other timbers are reproduced from an American source. (J. P. Taylor, Trans.Amer.So Mech.Engng.1943 p.201) and a 2 page bibliography of the subject is provided.

548. Macaluso, F. L. 1947 Amer.Soc.Mech.Engrs.Ann.Meet.,Pap No.47-A-115; abstr.in Mech.Engng,Apr. 1948,70,358.
RADIO FREQUENCY HEATING IN WOOD WORKING INDUSTRY. R.F. heating i very suitable for processes such as edge-gluing, plywood manufactu drying, and assembly gluing; typical equipment is illustrated and described. Variations of operating costs with generator rating a shown graphically. Generators are considered briefly and the F.C Regulations are explained in detail.

549. Netushil, A. V., Elektrichestro 4.12-17 1948 Bull.Brit.
Goldblatt, B. A. Sci.Inst.Res.Ass.3 231 1948 B.I.412 May 1949
HIGH FREQUENCY DRYING OF TIMBER. The advantages of the method ar discussed. Experimental curves and formulae are given for calcul ing the loss of water from the timber, taking structural anisotrop into account. A 50 k.w. generator for drying timber is described

550. Pratt, G.H. and Dean, A.R. Forest Prod.Res.Bd.Report No.474
Jan.1950 D.S.I.R.Library
RADIO FREQUENCY DRYING OF TIMBER. Apparatus used and results obtained from recent experiments are described. 1. Boiling off water from permeable woods. 2. Low power to produce moisture gradient in timber over which cool moist air is circulated.

551. Slade, F. H. Heatg.and Vent.Engr.22(255)p.114 Sept.'48
PROCESS HEATING BY ELECTRONIC MEANS. Drying curves for timber, initial M. Content vs. k.w.h/100 lbs. water removed, shew that the more total M. removed, the greater the economy. Except for 60% to 100% M. the consumption is about 35 k.w.h. per 100 lb. water removed. = about 1,000 B.T.U. per lb. water, but with timber starting with 30% M. 1,500 B.T.U./lb. are used.

552. Winkeler, P. Rev.Univ.Min.(90)34.Jan.1947.
Abstr.from Straling.Apr.1946
DIELECTRIC HEATING OF WOOD.

Infra-Red Drying

553. —— D.S.I.R.Rept.1948-9 For.Prod.Res.Laby.
Investigation has shewn that its usefulness will be limited by practical and economic considerations to items such as furniture squares cut from species with suitable properties, and where speed rather than cost is the over-riding factor.

554. Déribéré, M. Electricité,Oct.1947,31,199-200
DRYING OF WOOD BY INFRA-RED RADIATION. Comparative data for various woods are given regarding absorption and reflection of infra-red radiation, and power consumed in drying woods of different thickness. Illustrations of several ovens are given and the performance of that constructed by the Etablissements Proebster is considered. This oven is suitable for drying wood of thickness 5 - 25 mm.; with careful regulation of the distance from the lamps, warping is only slight. Reference is made to other applications, in particular to the drying of sawdust.

Chemical Seasoning

555. Anon. Business Week p.53-54.13.4.1946.
USE OF ORGANIC LIQUIDS. Treatment in closed vessel at 280-330°F. Removal of organic vapours by vacuum. Claimed to be much more rapid than kiln drying.

556. —— U.S.P.2,273,039.1941
TREATING WOOD AND WOOD PRODUCTS. Use of organic liquids for water removal.

557. Anon. The Timberman Sept.1942
SOLVENT SEASONING CONTROL. New Lumber Seasoning Method. Use of Acetone.

558. Anon. Chem.Tr.Jnl.124 No.3223 p.269.Mar.11 194
TIMBER DRYING BY MEANS OF XYLOL. One of largest wood preservation plants in U.S.A. has developed a method for drying green railway sleepers (prior to creosoting) by Xylol. Xylol vapour is passed in heated cylinder containing the wood, thence to separator to separate water from the xylol, which is returned to the cylinder. 6-14 hour for drying and it is stated that a charge of 800 sleepers may be mad to give up 4,000 gallons of water during that period.

559. Forest Products Res.Laboratory D.S.I.R.Rept.1948-9
Urea treatment is found to have no effect on the tendency to degrading on kilning of the Railway Executive stocks of oak.

560. Gottstein, J. W. C.S.I.R.O.Forest Products News Letter No.177 Sept.1949.2 pp.
VAPOUR DRYING. A discussion of vapour drying conditions, advantage and disadvantages. There is not sufficient data to assess the meri of the process. Illustrations and diagrams of an experimental equipment. The process is very rapid but by no means free from the faults of collapse, etc. Dangerous with present liquids (turpentin Most suitable for woods to be impregnated.

561. Grace, N. H. J.Phys.Chem.36,3046-63(1932)
Maass, O.
SORPTION OF VAPORS ON WOOD AND CELLULOSE. A special technic is described, which resembles that of Sheppard and Newsome (C.A.24,3641 In 20 woods examined for sorption of water vapor, 11 showed greater sorption by heartwood, 3 greater sorption by sapwood, the sorption being uniform in the other 6. Cotton cellulose adsorbed dry HCl from 1.26% in 17 hours up to 1.95% in 87 hours. White spruce heart wood showed for HCl, a sorption curve approximating that required by the Freundlich equation, thus differing from water sorption. Equivalent sorption values were reached more rapidly with wet than with dry wood. Wet cotton reached equivalent 30 times faster than cotton. The water first sorbed by cotton has a d. of 2.4; the d. drops on further sorption and becomes asymptotic in value to 1/. Th indicates a very intimate relation between the first few parts of water sorbed and the adsorbent. HCl sorption on wood containing 4% sorbed water shows corresponding phenomena. Water sorption does no follow Langmuir's adsorption formula $x/m = abp/(1+ap)$, whereas HCl sorption both by dry and by wet wood does follow this formula. Apparently with HCl there is surface sorption, while water enters pores as well (McBain). SO_2 sorption by cotton cellulose is slow, 100 hours being required for equil. Permanent change occurs becaus

initial values are not reproducible. Wood takes up more SO_2 than does cotton. The sorption of NH_3 resembles that of SO_2, but the sorbed gas is easily removed; but CO_2 is not appreciably sorbed. Wood does not materially sorb Et_2O or amylene, but takes up MeOH on a relatively large scale.

562. Harris Lebus Ltd. Light Metals pp.24-5 Jan.1950
AN INTERESTING CONVERSION. The furniture firm of Harris Lebus Ltd. has replaced old dryer doors by Aluminium sheet on wooden framework. Illustrated. Space filled with onazote insulation.

563. Hudson, M. S. Elect.World.126 90-3 14 Sept.1946 107-8 28 Sept.1946
POLES SEASONED QUICKLY IN HYDROCARBON ATMOSPHERE.

564. Hudson, M. S. N.E.Wood Utilisation Council Bull.18 67-9.1947
Vapour Drying by hot hydrocarbon vapours. With 9 inch pine poles, moisture is reduced from 90% to 35% in 10 hours.

565. Hudson, M. S. For Prod.Res.Socy; Ottawa 31 Oct.1947.
Artificial seasoning of woods in organic vapours.

566. Moll, F. Kunststoffe (Munich), 20, No.12, Dec.1930, pp.270-271
DRYING OF WOOD WITH AID OF CHEMICAL METHODS (DIE TROCKNUNG DES HOLZES MIT HILFE CHEMISCHER METHODEN). Review of patents which are divided roughly in two groups; drying by wrapping wood in water absorbing materials; drying by boiling in oil or other liquids.

567. Richardson, R. Pulp Paper Mag.Can., 32, 160-2, 1932.
SORPTION AND NATURAL PENETRATION OF ELECTROLYTES INTO WOOD. Forced Penetration of Liquids Into Wood and its Relation to Structure, Temperature and Press., J. W. Sutherland, Pulp Paper Mag. Can 32, 163, (1932).

568. Rietz, R. C. J.Forestry 35 No.3 Mar.1937 p.274-6.
SEASONING TRANSVERSE TREE SECTIONS WITHOUT CHECKING. Outline of chemical seasoning procedure developed at U.S. Forest Products Laboratory.

569. Stamm, A. J. Ind.Eng.Chem.27(12) 1480-4 Dec.1935
Hansen, G. A.
MINIMISING WOOD SHRINKAGE AND SWELLING. Replacing water in wood by non-volatile materials, e.g. waxes, resins, with a cellosolve vehicle for these.

570. Walkington Brit.Columbia Lumberman Apr.1942
CRYSTAL UREA IN SEASONING CONTROL.

Waste Materials

571. —— Univ.of Washington Engg.Exp.Stn.Bull. No.117.1950 D.S.I.R.Library.
THE PRODUCTION OF WOOD CAKE FROM WASTE WOOD.

572. —— F.I.A.T.Report No.444
DRYERS FOR WOOD CHIPS

573. Masonite Corp.Laurel.Miss. Chem.Eng.News.27(21)1534 23/5/1949
BY-PRODUCTS FROM WOOD CHIP EXPLOSION. Picture shewing a battery c
steam guns in which wood chips are reduced to fibre by the explosic
process.

574. Whalley, M. E. Nat.Res.Council.Publn.1285.103 pp. 7/1945.Canad.Chem.Proc.Industry 29 516 July 1945
ABSTRACTS ON UTILISATION OF SAWDUST. Contains 160 abstracts and 152 patents.

Fundamental Aspects

575. Baker, W. J. U.S.Dept.Agr.Repts.For.Prod.Lab.R.1652. July 1947
STRESSES DURING DRYING ARE DISCUSSED

576. Barkas, W. W. Trans.Faraday Soc.428 137 1946.Forest Prod.R.L.Reprint No.463
SORPTION SWELLING AND ELASTIC CONSTANTS OF THE CELL WALL MATERIAL I
WOOD. Expressions are given for the change of sorption and of anisotropic swelling in a gel with the change of stress applied. The theory is applied to the swelling of spruce wood in specially designed clamps, and calculations made of the principle elastic constants.

577. Barkas, W. W., F.P.R.L. Proc.Paper Makers Assn.G.B.I.28 1.1947
THE SORPTION AND SWELLING OF CELLULOSE UNDER NATURAL AND IMPOSED RESTRAINTS. The effects of restraints on sorption and swelling of cellulosic materials are closely examined. The sensitivity to
stress provides a plausible explanation of the sorption hysteresis
The relation between vapour pressure, moisture content, swelling,
and applied directional stresses is governed by equations which ma
be used for calculating the elastic constants of swelling material
and for predicting their behaviour under practical conditions.

578. Barkas, W. W. Forest Prod. Res. Lab. H. M. S. O. 1949
THE SWELLING OF WOOD UNDER STRESS. 98 pp. A discussion of its hygroscopic, elastic and plastic properties. Based on a course of Lectures given by W. W. Barkas at Svenska Träforstningsinstituet. Stockholm 1948. Chapter V. Sorption hysteresis.

579. Burr, H.K., Stamm, A.J. J.Phys.Colloid Chem. 1947, 51, 240-261
DIFFUSION IN WOOD. An investigation has been undertaken to check the diffusion values predicted by Stamm's equations (as yet unpublished) by measurement of diffusion constants in softwoods and in regenerated cellulose, and to determine to what extent these equations may be used for hardwoods. Four types of measurements were made: the electrical conductivities of several species of wood saturated with salt solutions were determined; direct measurements of relative diffusion constants were made; a series of microscopic measurements was made on a number of different species in order to determine to what extent certain of the structural dimensions differed from those taken by Stamm as typical of softwoods; and measurements of the rate of transfusion of water vapour through wood and through regenerated cellulose were made by the steady-rate method. The longitudinal relative conductivities of softwoods agree with the predicted values, whereas the transverse values are lower than those predicted by 26 to 46 per cent. For hardwoods the longitudinal values fall somewhat below the theoretical curve and the transverse values are widely scattered. Direct diffusion-rate measurements show that the relative electrical conductivity is equal to the relative diffusion constant. The microscopical examination reveals wide variations between softwoods and hardwoods, accounting for the inconsistency of results when the equations are derived for softwoods are applied to hardwoods. The rate of transfusion measurements are in fairly good agreement with theoretical values.

580. Erickson, Schwitz, Gertner Univ. of Minnesota Agric.Exp.Stn.
July 1937 Tech. Bull. 122
PERMEABILITY OF WOODS TO LIQUIDS; AND FACTORS AFFECTING RATE OF FLOW. 40 pp. and bibliography.

581. Hawley, L.F., Wiertelak, J. Indus. and Eng. Chem., 23, No. 2, Feb. 1931, pp. 184-186. and Paper Makers monthly Jnl. 69 (5) 187-191 15.5.31
EFFECT OF MILD HEAT TREATMENTS ON THE CHEMICAL COMPOSITION OF WOOD. Analyses are recorded of white ash and Sitka spruce wood before and after heat treatments in closed iron tube at 138 degrees centigrade for 2, 4 and 8 days; in both woods losses are largely in carbohydrate constituents and there are also gains in lignin and alcohol-benzene soluble; in both woods methoxyl content remains practically constant.

582. Johnston, H.W., Maass, O. Research Notes. Pulp and Paper Mag. Canada. 2 53-83. 1929.

PENETRATION OF MOISTURE INTO WOOD.

583. Kollman, F. Forschung 6,169-174(1935)July/Aug.
MATHEMATICS APPLIED TO THE DRYING OF LUMBER. I. Introduction. II Previous Researches. III Drying, a problem of diffusion. IV Practical equations for the drying time. (a) Influence of unit weight and structure, (b) thickness, (c) moisture content, (d) temperature, (e) rel. humidity, (f) quality of drying chambe and the kind of service. V Summary.

584. Maclean, J.D. Amer.Soc.Mech.Engrs.55 Wood Industries
Madison, Wis. 55-61 1933
MOISTURE CONTENT, S.G, AND AIR SPACE IN WOOD. An exposition of th physical aspects of wood. Cell structure and physical changes on drying or impregnating. Formulae and graphs, of interest to those engaged in kiln drying, wood preserving, or fire proofing.

585. Pridgeon and Maass Research Notes, 3,47-50.1930.Pulp Paper
Mag.Can 31,530,1931
PENETRATION OF WATER INTO WOOD.

586. Scarth, G. W. T.A.P.P.I.June 1928 p.94 Series XI No.1
THE STRUCTURE OF WOOD AND ITS PENETRABILITY. Pictures of results study of mercury penetration into different woods. Bordered pits well defined.

587. Schwalbe, C. G. and Kolloid Zeit.,54,No.3,Mar.1931,pp.314-
Berndt, K. 326,7 figs.; see also brief translated
abstract in Chem.and Met Eng.,38.No.5,
May 1931,p.291
DIE HYGROSKOPIZITAET VON HOELZERN VERSCHIEDENER TROCKNUNGSART (HYGROSCOPICITY OF WOOD). Study of influence of drying condition and of swelling behavior on hygroscopicity of wood; factors investigated were: hot-air drying, drying in oxygen and in nitroge pre-swelling in wet steam, reversibility of swelling, and drying wi organic solvents.

588. Stamm, A. J. Physics 1(2)116 1931
CAPILLARY STRUCTURE OF WOOD.

589. Stamm, A. J. Discuss.Farad.Soc.No.3 264-272 1948
THE PASSAGE OF WATER THROUGH THE CAPILLARY STRUCTURE OF WOOD. It is shewn that diffusion through wood can be of three types and can calculated from the capillary structural data.

590. Stevens, W. C. Forest Products Research Lab.7 March 19
D.S.I.R.Library
PRELIMINARY TESTS DESIGNED TO INVESTIGATE THE EFFECTS OF TEMPERATUR GRADIENTS ON THE DRYING OF WOOD. One face of timber board kept in contact with a heated surface, and the other face exposed to a lower temperature. Moisture flowed towards the cooler face.

Moisture distribution values at various stages in drying were recorded. Graphs shewing comparison with kiln treatments, etc.

591. Tiemann, H. D. J.Frank Inst.188 27 '19.
DRYING WOOD. Internal stresses set up on drying.

592. Tamura, M. Jl.Franklin Inst.200 p.609.1925.
DRYING THEORY. Applies diffusion of heat equation to the drying of wood - experimental data on conc. gradient.

593. Tuttle, F. J.Franklin Inst.200 609-614.1925.Nov.
A MATHEMATICAL THEORY OF THE DRYING OF WOOD. The various phenomena occurring in the drying of timber are referred and a theory is advanced which is based by analogy on the Fourier heat-conduction analysis. Experimental data are given in support.

Moisture Relations

594. Barkas, W. W. Nature 130 609 1932
RETENTION OF MOISTURE IN WOOD.

595. Grace, N.H., and Maass, O. J.Phys.Chem 36,3046-63.(1932)
SORPTION OF VAPORS ON WOOD AND CELLULOSE. Equil. sorption values reached more rapidly with wet than with dry wood. Same with cotton.

596. Henderson, H. L. Trans.A.S.M.E.54 #4,21-25('32)
EQUIL. MOISTURE FOR WOOD. Moisture % of wood for various purposes.

597. Neubruch, W. L. Amer.Artisan 117(3)88-90 March 1948
(5)83-86 May 1948
WOOD AND RELATIVE HUMIDITY, I AND III.

598. LOUGHBOROUGH, W. K. Furniture Mfr.44 43(1932)Oct.
STUDY OF MOISTURE PICK-UP IN DRY LUMBER. Results and applications of several investigations made at Forest Products Laboratory.

599. Schwalbe, C. G. Papier-Fabrikant 32 No.3 Jan.21.1934, p.25-30
DIE KOLLOID - CHEMISCHEN EIGENSCHAFTEN DES FICHTENHOLZES. Colloidal properties of coniferous wood, drying of wood, experimental determination of effects of air of varying moisture content; curves showing relative penetration of liquid water into green wood, air-dried wood, and completely dried wood; penetration of electrolytic solutions and effects and measurements of swelling thus caused.

600. Schwalbe, C. G. and Berndt, K. Kolloid-Z.54,314-26,(1931)Mar.abst.in Chem.Met.Eng.38,291(1931)May
HYGROSCOPICITY OF WOOD. Study of influence of drying conditions and of swelling behavior on hygrosopicity of wood; factors investigated were: hot-air drying, drying in oxygen and in nitrogen; pre-swelling in wet steam, reversibility of swelling, and drying with organic solvents.

601. Spiller, D., Plant Diseases Div.D.S.I.R. NZ. New Zealand Jnl. of Science and Technology. 30(1) 24-26 July 1948
EFFECT OF HEAT TREATMENT ON EQUIL. MOISTURE CONTENT OF THREE N.Z. GROWN WOODS. Samples heated at 86°, 105°. 115°, 130°, 150°C. for 24 hours. Reduction in hygroscopicity was measured by comparison with unheated samples. This reduction is permanent. Heating below 160°F does not impair toughness, hardness etc. by more than 10 but the reduction in hygroscopicity is important for dimensional stability in ambient air.

602. Warlimont, P. Maschinenbau, 10, No. 2, Jan. 15, 1931, pp. 47-50, 5 figs.
UEBER DAS ARBEITEN DES HOLZES (SHRINKING AND SWELLING OF WOOD). Investigation of age and treatment of wood shows that they have no effect on ability of absorbing moisture with changing moisture content of air; only possible protection is proper painting.

603. Welch, M. B. Roy. Soc. New Sth. Wales. 64, 337-51 (1931) June.
EXPERIMENTS ON MOISTURE IN TIMBER.

Moisture Determination

604. ---- For. Prod. R. Lab. Leaflet No. 7. Revised July 1940
MOISTURE CONTENT DETERMINED BY THE OVEN DRYING METHOD. Apparatus and Method of Determination. Drying to constant weight at 95-105° of a suitable cut sample.

605. ---- Forest Products Res. Lab. D.S.I.R. Leaflet No. 7 July 1949
MOISTURE CONTENT DETERMINATION BY THE OVEN-DRYING METHOD. Method of sampling and determination. The oven method is more reliable than the method of measuring electrical resistance. Diagrams of oven method are given.

606. Anon. Engineer, 21 May 1948, 185, 497
ESTIMATION OF MOISTURE IN TIMBER. Measurement of the water content of wood may be determined in a few minutes by electrical methods usi either very small quantities of the wood or by testing the wood in situ. In the first method, samples are dried by infra-red rays operating inside a sensitive balance. In the second method, small spikes are pressed into the wood, the spikes being connected to an electronic tester capable of recording variations in conductivity caused by water in the wood and thence determining the proportion of water present. Apparatus for the two methods are described. E.R.A.

607. Maskiner, E. C. J. Sci. Instr., 24, 219. August, 1947
MOISTURE METER FOR TIMBER. An instrument is described whose operation depends on the change in capacity of a condenser.

608. Ebert, Fr. Holz. 2(9) 132-3 1948
DETERMINATION OF MOISTURE IN WOOD. Brief descriptions of various methods for determining moisture, together with the usual moisture ranges permitted in woods used for various purposes.

Equipment

610. Anon. Tonindustrie-Ztg, 55, 455, 1931 April 16
DRUM DRYERS. Buckaner dryer for drying ceramic products according to uniflow or counter-current principle.

611. Anon. Keramische Rundschau 45 n 15 Apr. 14 1937 p 163-5.
DRYING OF CLAY IN FINE CERAMIC PLANTS. Illustrated description of drying chutes installed in various types of ceramic kilns; economy and advantages pointed out.

612. Anon. Brick, Clay Rec. 99(4) 32 1941
ROTARY DRYER SOLVES AN URGENT PROBLEM. Contains a 4 inch screw conveyor and baffle plates. With 15-30 gallons of oil (vaporised by steam at 100 lbs. pressure), 10 yards of clay per hour are dried.

613. Anon. Brit. Clayworker 1941, 50, 20)
ROTARY DRYER. A rotary dryer for partially drying clay before it is made up by the semi-dry process is described. It consists of a cylinder 50 ft. long and 5 ft. in diameter. The heating is by an ordinary coal-fired furnace. Dryers of this type are in use within this country and the U. S. A. (From Trans. Brit. Ceram. Soc. 1941, 40, 66A)

614. Anon. Brick Clay Rec., 99, No. 6, 45, 1941)
NEW HOT-FLOOR DRYER USES UNIT HEATERS TO CUT DRYING TIME. A new dryer housed in a building 100 ft. x 120 ft. and giving 12,000 sq. ft. extra drying space was designed. Ware is placed on the solid concrete floor and all drying is done by 10 steam unit heaters. Four of the unit heaters are mounted on shafts on recirculation boxes 12 ft. high, and 3 unit heaters are mounted on 9 ft. shafts all placed along two walls of the room. The other 3 unit heaters are suspended from the roof. The 12 ft. high recirculation boxes are connected to the outside air by means of a sheet metal connection through a window. Each of these boxes has a damper in the shaft, so that the amounts of recirculated and fresh air through the unit heater may be controlled. The 9 ft. high units handle only recirculated air. The ceiling heaters take the hot air that collects under the roof and send it back to floor level over a wide area.

615. Anon. Indus. Gas, 15, No. 12, 13, 1942
DRYING PROCESSES WITH GAS HEAT. When available, gas is largely used for drying clay; the moisture content is reduced to 5 or 8%. The dryers themselves may be of the rotary or tunnel types. A less common design is the internally heated drum, the clay being picked up from a vat of slip by ropes wrapped round the circumference. The dried clay falls off due to flexing of the ropes as they become dry.

616. Anon. Brit.Claywkr., 52, 149, 1944

CORRIDOR DRYER. This dryer is heated partly by hot air from the cooling chambers of a continuous kilm and partly by four gilled tub through which either hot water or steam is circulated. The hot ai from the kiln enters the flue and rises past the hot tubes and amon the bricks. After the danger stage of drying has been passed hot air is admitted through the flue and the moist air from the drying bricks is drawn off. The heat from the gilled tubes must be sufficient to raise the temp. to 27-30°C. Additional heat is provided by the hot air from the kiln for the later stages of the drying. Each chamber is under separate control.

617. Anon. Pott.Gaz., 69, 320, 1944.

SPEEDING UP CUP DRYING. A new automatic dryer consists of a metal chamber 9 ft. high by 5 ft. long by 3 ft. wide, in which are twelve trays, arranged one under the other a foot apart. These trays are supported on two endless chains in a vertical shaft, the cup moulds being introduced through a convenient opening, situated, in this case, at the right-hand side of the machine at bench level.

618. Anon. Pott.Gaz., 1946, 71, 530

POTTERY DRYERS. The following advantages are claimed for a patent rotary dryer by Wm. Boulton, Ltd., Burslem:
(i) Elimination of mould running. (ii) Economy in the use of stea
(iii) No escape of heat from dryer to workshop. (iv) Saving in we and tear of moulds. There is a considerable saving in space and electrical power, as compared with mangle dryers made by the same firm, and heat is more accurately controlled. A dryer 11 ft. squa has sufficient accommodation for a plate-maker engaged on making larger sized plates. B.R.R.A.

619. Anon. Elect. Rev., P.971, 26th Dec. 1947

POTTERY DRYING. In a steam-heated plant for drying green ware a 10-k.W electric heater has been substituted for the steam coil. In another plant the heating coils are retained but a 150-kW. 415- electrode boiler is employed. This is sufficient to cope with the output of nine jiggers. It is automatic in operation and may be installed close to drying areas, thus eliminating heat losses in lo pipe runs. A further advantage is its cleanliness. (3 figs.).

620. Anon. Ceram. Industr., 49, No.2, 81, 1947

DRYING 80,000 POUNDS OF SANITARYWARE IN 24 HOURS. A counterflow dryer is described, the cars of which carry either 1,800 lb. vitreo glazed earthenware or 1,200 lb. vitreous china, having a total capacity of 80,000 lb. At the hot end provision has been made for a mixing chamber into which waste heat may be introduced, and at which tempering of the air may be accomplished. The waste heat wi be derived from a heat interchanger placed on the exhaust system of Dressler tunnel kiln. Drying time for the heaviest pieces of ware is approximately 22 hr.

21. Anon. Pott. Gaz. Glass Tr. Rev., 73, 129, 1948
NEW ELECTRIC DRYING STOVES. A new electric drying stove can be adapted for either hollow-ware or flatware. Economical in space, time and labour, the drying cycle is 30 min. for dipped ware and 80 to 100 min. for clayware. Whilst improving working conditions, the estimated increased output is not less than 33 %, and ware boards are eliminated. Operating on the mangle principle, trays of ware are fed in at one side and removed on the other. Electrical control regulates the passage of ware through the machine. Two on dipped ware can cope with the whole production of a five-oven factory, the labour required being two dippers and four assistants and the space required only 30 ft. x 30 ft. Output of dipped flatware, 8-in. scallops and oval bowls up to 10 in. is 48 doz./30 min. Drying is effected by unit heaters. (2 figs.)

22. Clauss, R. Tonind. Ztg. 66, 49, 1942
TYPES AND APPLICATION OF AIR HEATERS.

23. Coulhon, A. Industr. Céram. No. 384 (58) 1948
THE PRODUCTION OF HEAVY CLAY WARE. Some dryers are described, and the principles of forced convection are discussed.

24. Comstock, G. F. J. Am. Ceram. Soc., 16, 12 (1933)
CERAMIC DRYERS. Procedures in 22 plants are given.

25. Crittall & Co. Waldram, H. D., Br. Pat. 620,922 31/3/49
Reid, W. H., Voaden, G. W.
IMPROVEMENTS IN OR RELATING TO CIRCULAR DRYING OVENS. The outside of a circular drying oven is a casing in which is a loading aperture. Inside the casing is a vertical shaft carrying a number of shelves which can rotate independently. Successive portions of the shelves can be brought into register with the loading aperture. In at least one shelf there is a gap, to facilitate loading.

7. Fidelman, S. O., Gatovsky, A. M. Ogneupory, 1948, vol. 13, 51
HEAT ECONOMY IN REFRACTORY PLANTS. A general review is given of the various types of dryers and kilns used in the manufacture of refractories. The advantages and disadvantages of intermittent, Hoffmann and tunnel kilns are considered. Of the kilns used for firing firebricks, in the U.S.S.R., 13.5% are intermittent, 43.0% Hoffmann, 17.5% gas-fired annular, and 23.5% tunnel kilns. One factory uses gas-fired chamber kilns for firebricks. 17.5% of the silica bricks are fired in tunnel kilns, 54% in gas-fired chamber kilns and 28.5% in intermittent kilns. Magnesite and chrome-magnesite refractories are fired in gas-fired chamber kilns, and at one factory in tunnel kilns. Special refractories are fired in intermittent kilns by fuel oil or gas of high calorific value.

630. Gallons, G. Tonindustrie Ztg., 56, 1162, (1932)
DIE WARMLUFT-GEBLASETROCKNEREI: Hot-air blower drying plants, schematic drawing showing layout of plant with blower for dryers located on side of ring kiln; advantages of this type of drying plant.

631. Garve, T. W. Bull. Amer. Ceram. Soc. 20, 117, 1941
TUNNEL DRYER REFINEMENTS. Baffles and other design features are described to promote improved air circulation.

632. Garve, T. W. Bull. Amer. Ceram. Soc. 27, 299, 1948
ACCELERATED RADIATED HEAT DRYER. An improved design for a waste heat tunnel dryer is presented having greatly increased radiating surface and additional air circulation. (2 figs.)

633. Gatzke, P. Tonind. Ztg. 1942, 66, 227
PROPOSALS FOR STANDARDISATION OF KILNS, DRYERS AND GAS PRODUCERS IN THE CERAMIC INDUSTRY. The Kiln-Construction Subsection of the Wirtschaftsgruppe Bauindustrie, Berlin, has drawn up proposed standards for the dimensions of kilns, dryers, and gas producers. Five, or in some cases six, standard capacities or outputs are recommended for various types of kiln and dryer, and the corresponding internal and external dimensions, grate area, etc., are tabulated. (Trans. Brit. Ceramic Soc. 1943, 42, 19A).

634. Hebenstrei Ceramic Ind. 40(3) 50, 1943
ALL WELDED DRYING SYSTEM SAVES OVER 3,000 DOLLARS YEARLY. Describes two large permanent overhead drying conveyors erected over the top of a 70 foot circular tunnel kiln, and later 8 more.

635. Helm, G. Ber der Deutschen Keramischen Gesellschaft v 13 n 10 Oct, 1932 p 454-7.
NEW ROCKER-TYPE DRIER FOR DRYING OF CERAMIC BODIES.

636. Loeser, G. Sprechsaal 64,807-10 (1931) Oct. 24. 65 231-4, 1932.
A TUNNEL DRYER WITH ROLLING CHARGE FOR THE CERAMIC INDUSTRY. A description of a tunnel dryer with three horizontal corridors with heating coil partitions. Cars carrying the charge moving through the tunnel while fans in the side circulate the air across the cars and back under the floor. The air is drawn in the car discharge and exhausted at the entrance.

637. Laurin, F. Industr. Ceram., 1948, No. 385, 78; Brit. Ceram. Abstr., 1949, 6A.
DRYING OF CERAMIC PRODUCTS. Tunnel and rotary dryers of the parallel-flow or countercurrent types are described briefly. For non-ceramic purposes the evolved vapour may be used as a drying agent, or drying may be performed under reduced pressure.

638. Longenecker, H. L. Brick & Clay Rec 86 n 3 Mar, 1935 p 99-100.
CORRECTING FAULTS IN WASTE HEAT DRYERS. Progressive type waste-heat tunnel drier, generally used in clay-products industry, is simple in construction and operation, built almost entirely of materials produced by clay plant.

639. Maddock, J. & Sons, Maddock, R. A., Brit.Pat., 590,124, 9/7/47.
Johnson, J. A.
IMPROVEMENTS IN AND RELATING TO POTTERY DRYING STOVES. A pottery drying stove is described in which the goods are carried through the stove by means of a swinging tray conveyor, or other equivalent moving carrier, wherein supports for the goods hold the latter in an inclined position, heating or drying means being so arranged that in their travel through the drying zone of the stove the goods are subjected to the direct impingement of heat. (6 figs.)

640. Martin, R. Ceram. Industr., 1946, 47, No. 1, 707.
NEW GAS-FIRED PRODUCTION LINE DRYER. This dryer, now being used in America for dinnerware, consists of a woven wire conveyor, black panel radiant drying section, convection drying section, and a mould return conveyor. It is 46 ft. long 6 ft. 5 in. wide, and approximately 8 ft. 8 in. high. The radiant drying panel is 20 ft. long and 4 ft. wide and is situated at the loading end of the conveyor.

641. Miller, W. J. Ceram. Age. 1944, 44, 104; Brit. Ceram. Abstr. 1945, 44, 2A.
DEVELOPMENT OF POTTERY MECHANISATION. The mechanisation of the American pottery industry is discussed with special reference to the

author's jigger and stove designs. The Miller dryer depends for its efficiency on the use of a turbulent stream of hot air, which ma conveniently be recovered from above the kilns. The combination o Miller automatic jiggers with this dryer in an American pottery with a daily output of 26,000 doz. is described. All ware emerges from the dryer at one point, so that a co-ordinated conveyor system can used to take the green ware to the subsequent processing rooms.

642. Oliver, H. Trans.Brit.Ceram.Soc., 46,215, 1947.
SOME ASPECTS OF HOT-FLOOR DRYING. Construction of the under-floor a steam-heated drying floor is considered, and the advantages and disadvantages of floors surfaced with tiles and concrete are compare with those surfaced with steel or cast-iron plates. Other points dealt with include the application of steam, operation of drying floors, and details connected with the drying of siliceous, silica, sillimanite and fireclay goods.

643. Schnell, W. Tonind. Ztg., 66, 199, 1942.
THE TUNNEL DRYER. The tunnel dryer is able to deal with tender clays at a much more rapid rate than the hot floor or chamber dryer. If run over-night with reduced heat input and stationary cars, as i normally the case, the drying zone may move back towards the chargin end so that the first cars to enter next day may be dried too quickly. Unequal operating conditions in day and night-working ma also occasion wastage of heat or condensation on the ware. Full efficiency will not be attained until brick or tile production is organised on a 24-hour basis.

644. Shufflebottom, G. W. Brit.Pat. 588,883, 5/6/47.
IMPROVEMENTS IN DRYING APPARATUS. An apparatus is described for drying pottery, more particularly when in moulds. A lagged outer cylinder contains a number of hollow circular shelves which rotate. Hot air is forced into the cylinder and passes through apertures in the shelves during circulation. (4 figs.)

645. Schulz, G. Tonindustrie-Ztg. 55, 1126, (1931) Oct. 5.
OPEN-AIR DRYING PLANTS. Automatic settling device with scaffold frame used in connection with open-air drying, with special referenc to Hartmann system.

646. Straight, H. R. Bull. Am. Ceram. Soc. 18, 427, 1939
A RECIRCULATING RADIATED WASTE HEAT DRYER OPERATED UNDER CONTROLLED HUMIDITY AND TEMPERATURE. A feature of this dryer is the circulatio in appropriate directions through the ware by airplane type propellers.

647. Anon. Tonind. Ztg., 57, 953-5, 1933, Oct. 9.
DRYING CLAY. Slurry Drying with Mechanical Appliances.

648. Anon. Ceram. Ind. 34, 56, 1940.
THE A.B.C. OF DRYING. The subject is treated simply for non-technical readers. Movement of water through the pores of a ceramic body, reasons for shrinkage and definitions are given.

649. Anon. Tonind. Ztg. 65, 499, 509, 1941.
THE DRYING OF CLAY. Artificial drying should not be done if bonding power and plasticity are reduced. A dryer is described which is a flue running up a waste tip. The clay passes down against the rising flue gases.

650. Anon. Brit. Claywkr., June 1946, 55, 33.
DRY FUEL. The heat given off from the cooling arch of a kiln may be used to pre-dry the fuel, thus aiding its speedy ignition.

651. ---- Eng. Expt. Stn. News. OHIO State, Univ. Oct. 1950.
MODERN EQUIPMENT AND PRACTICES IN THE CERAMIC INDUSTRY. Short articles on modern practice, profusely illustrated.

652. Anon. Trans. Brit. Ceram. Soc., Aug. 1947, 46; 207-215.
DRYING OF CLAYWARE - A DISCUSSION. The discussion covers the following major topics; types of dryer, their design and efficiency; the construction of hot-floor dryers and their operation in the drying of silica and siliceous refractories and of large sillimanite blocks; the effect of air velocity and the use of hot air from kilns; the cost of infra-red drying. Other factors bearing on the general problem of drying clayware are also briefly considered.

653. ---- B.I.O.S. Final Report, No. 473, Item 22.
THE MANUFACTURE OF HEAVY CLAY PRODUCTS IN GERMANY. German clayworks appeared to be built to plan and for a particular process or output. Drying was usually carried out in buildings of several storeys above the kilns, and the degree of mechanisation for conveying raw materials and green articles was considerable. At a number of works, machinery was driven by individual electric motors. Full description of plant and process at various works.

654. ---- B.I.O.S. Final Report 1123.
P.5. WARM AIR DRYER OF USUAL DESIGN.

655. ---- B.I.O.S. Final Report 1315.
GERMAN HARD PASTE PORCELAIN. EARTHENWARE & TABLEWARE INDUSTRY.
P.12. Waste heat drying. Inverted hollow ware.

656. —— B.I.O.S. Final Report 1551.
GERMAN FLOOR TILE FACTORIES. P.12. Batch and Tunnel drying. P.15. Preheating before kilning. Tunnel dryer. P.38. Open shop drying. Very little detail.

657. —— B.I.O.S. Final Report 1792.
GERMAN LABORATORY PORCELAIN INDUSTRY.

658. Bailly, L. Cer. Age 55, 168-72, 1950.
NEW DEVELOPMENTS IN FIRING AND DRYING PROCESSES.

659. Balkovitch et al. Gonchar P. D. Steklo i Keramika 8 No. 2 1951.
P.12. Experience with combined grinding and drying of clay.
P.16. The combined grinding and drying of clay in a shaft mill.

660. Barta, R. Ind. Ceram. No. 375, 196, 1947. Br. Ceram. Abstr. 9A. 1948, B.I. Nov. 1948, 610.
CONDITIONS FOR CORRECT AND RAPID DRYING. Aim of drying is to accelerate expulsion of water from the centre to the outside without undue delay. Attempts made were discussed. Vacuum, High Frequenc Humidity drying, and by pressure between porous discs. Humidity drying comprises preheating, primary and final drying.

661. Blair, M. M. Am. Cer. Soc. Bul. 16 n 9 Sept, 1937, p.361
WASTE IN DRYING. Waste of power, fuel, and products in drying structural clay products, due to obsolete equipment and careless operation is discussed, and possibilities of actual cash savings in operation and regulation are suggested; example of construction and operating absurdities are cited.

662. W. Boulton Ltd. Gaskell, T. H. Brit. Pat. 573,349, 16/11/45.
IMPROVEMENTS IN AND RELATING TO THE DRYING OF CLAY. This patent relates more especially to the drying of wet or plastic clay, such a that which has been removed from filter-presses preparatory to grinding it into dust for the production of tiles or other purposes, the intention being to expose a greater surface area to dry than otherwise would be possible. The wet or plastic clay is placed in a form of pug or other machine and extruded or otherwise produced in the form of a number of strips or ribbons which in cross-section may be circular, rectangular or other shape as desired. The strips may be indented, reduced or severed at intervals in their length, or of uniform cross-sectional form throughout. Conveyors can carry the shaped material from the moulding machine to the grinder via the drying chamber. (2 figs.)

663. Brown, W. S. Cer. Age 19 n 1 Jan, 1932 p.8-10.
DRYING CLAYS BY SPRAY PROCESS. Characteristics of Bowen process of spray drying; results of two tests on clay slips; controlled segregation possible. Before N. J. Clay Workers Assn.

664. Bullain, I. A. Bayreuth Sci. Libr., 1938; F.I.A.T. Microfilm Reel D 336, Frames 7478-7730; U.S. Dept Commerce, Off. Tech. Serv., PBL74267

HEATING TECHNIQUE IN PRODUCTION OF THIN-WALLED CERAMICS. The construction and operation of kilns for roasting the starting material as well as various processes of drying and types of drying tunnels are described in detail.

665. Carothers, T. E. Cer. Ind. 54(6) 101, 1950

INSTANT DRYING ELIMINATES FILTER PRESSING. Description of spray drying tower and formation of pelletised slip.

666. Carruthers, J. L. Am. Ceramics Soc. Jl., 14 No. 1, Jan. 1931, pp. 8-20, 4 figs.

DRIER PROBLEMS WITH CALCULATIONS. Importance of proper drying of clayware and causes of drier troubles; use of humidity chart in control and design problems: Carrier Humidity chart is used in illustrating solution of several typical problems, viz., air and heat requirements and control of condensation in waste-heat and radiated-heat types of driers. Bibliography.

667. Carruthers, J. L. Trans. Amer. Soc. Mech. Engrs. 58(3) 240-4 Apr. 1936

DRYING PROBLEMS IN THE CERAMIC INDUSTRY. Various problems encountered in designing and operating drying systems; indication of several methods that may be used in attacking more difficult problems that may arise. Discussion of paper to A.S.M.E. June 19-21 1935. Trans. 57 439-41. Oct. 1935.

668. Cox, P. E. Ceram. Age, 52, 73, 1948)

CLAY PREHEATING VERSUS HUMIDITY DRYING. The first reaction of many manufacturers to pre-heating highly colloidal or "gumbo" clays is that the heat is wasted and consequently the cost is too high. Nevertheless pre-heating reduces firing time, warpage, dry cracking and sometimes shrinkage. Humidity drying systems will not handle some bentonitic clays, but can be employed after pre-heating treatment. Temperatures for pre-heating are not important between 430° and 540°C. but the higher value should not be exceeded. Consideration is given to brick and tile making with the use of colloidal and bentonitic or "sticky clays", and one example shows that pre-heating eliminated oxidation trouble. Usually a satisfactory dry strength is secured, but adhesives may be used if required. An experiment showed that a fresh clay mixed with a pre-heated clay to a point too high for plasticity to exist (75% pre-heated clay, 25% unheated clay) expedited oxidation of sulphur compounds. (2 figs.)

669. Davis, J. Claycraft, 22(22) 1948. Br. Cer. Abstr. 48(4) 1949

CLAY PROCESSING PLANT. A self-contained plant which processes wet lump clay down to a finely powdered product, i.e. claycutter, feeding to a vertical air stream and on to an expansion chamber. 4 figs.

670. Deckenmeyer, H. J. Brick and Clay. Rec. 117 (4) 5. Oct. 1950

FUNDAMENTALS OF THE DRYING PROCESS. A survey of the views on the mechanism of drying clay ware.

671. Falke, E. Tonind. Ztg. 66, 361, 1942

THE INFLUENCE OF DRYING AND BURNING CRACKS ON PROFIT. Nomograms a reproduced to aid in the calculation of the effect of drying and fi cracks on the profits. It is shown that if improved manufacturing methods can be made to decrease drying and firing cracks the cost o such improvements in plant is likely to be repaid very quickly.

672. Forrester, J. N. Claycraft, 21, 232, 1948

THE SCIENTIFIC CONTROL OF CLAYWARE DRYING. Some control of the humidity is necessary to ensure even drying of the green ware and recordings should be kept to assist in this: some methods of produc ing artifical humidification are suggested. The method of drying which is favoured is by heat from exhaust steam of 3-5 lb. back pressure. More scientific placing of ware is worthy of considerati and much general ware could be tunnel-dried. It is suggested that experimental room be set aside to dry out various ideas for drying. (1 table).

677. Gardner, A. Williams Tr.Br.Cer.Soc. 49 (3) 129-140. March 1950
IX - POTTERY DRYING. A broad survey of drying and dryers, outlining the problems facing potters and engineers. Sections are:- Introduction and Factors in Drying, Stages in the Drying Process, Methods of Heat Transfer, Application of methods of Heat Transmission, Effects of Mechanisation, Dryer Efficiency, Waste Kiln Heat, High Frequency Drying.

678. Garve, T. W. Am.Cer.Soc. Jv 16 n 2 Feb. 1933 P.118-23.
MODERN WASTE-HEAT TUNNEL DRIERS. Use of driers utilizing all waste heat available from kiln firing and cooling; faults of waste-heat tunnel driers in reference to manner of heat application are eliminated by methods reaching vital points, incorporated in driers of following types: hot air (waste heat) from top, combustion gas from bottom (optional); hot air (waste heat) from bottom, combustion gas from bottom; and hot air (waste heat) from bottom.

679. Garve, T. W. Cer.Age. 53(6) 54(1 to 6) June to Dec. 1949
55 1 and 2, 1950
DRYING PROBLEMS. A series of papers dealing with equipment and various aspects of drying (clay products).

680. Gen.Refractories Co., Balt. Md. Chem.Eng.News. 27, 31, 1/8/1949.
2214/5
A NEW REFRACTORIES LABORATORY. Pilot Plant facilities.

681. Gerber, A. C. Am.Cer.Soc.J. 20 n 2 Feb. 1937 p.56-9.
DEVELOPMENT OF SUCCESSFUL PERIODIC HUMIDITY DRIER FOR GROGGED WARE. Test procedure, results of tests, and operation of commercial size test drier used on heavy clay grog ware.

682. Gordan, C. W. Chem.Eng.Progress. 45, 8.
Comb. Eng.Co.Chicago. 477-481 Aug. 1949
FLASH DRYING. This paper includes data on the mill-drying of clay. Consumption is 1,700 B.T.U. per lb. water evaporated.

683. Hartmann, G. Tonind.Ztg. 121-2, (1932) Jan. 28
ECONOMY OF MODERN OPEN AIR DRYING PLANTS.

684. Hummel, R., Twells, R. Bull. Amer.Ceram.Soc. 19, 434, 1940
RECIRCULATING AIR APPLIED TO CERAMIC DRYING. The products of combustion from modern low-sulphur fuels may often be used directly for drying ceramic ware. Recirculated air reduces temp. of combustion gases, and fresh hot gases are added from time to maintain temp. and replace the small volume exhausted from the stock. The application is described.

685. Hursh, R. K., Hagen. - Clayworker. 92, 117-123, 1929. 95. 258. 1931
CLAY DRYER TESTS.

686. Jennings, A. C. Claycraft, 20,424,1947
RANDOM THOUGHTS ON GAS AND CLAY. In dispersing moisture from clay, the four chief factors are the humidity, pressure, and movement of the surrounding atmosphere and the temperature of the water in the clay. It is suggested that removal of water from thick sections could best be carried out by first creating conditions conducive to drying, but without any drying taking place, and then to extract water thus vaporised by control of humidity and pressure. For this purpose boilers fired with town gas are deemed to be ideal steam raisers. Forced convection of warm air at speeds above normal and the use of radiant heat emitters are discussed for the drying of thinner sections. A number of points are raised concerning the calcination of gypsum moulds and dryer conditions, and it is stated that a gas-heated radiant heat emitter recently marketed meets most of the requirements. Americans have been using such burners set in the side walls of direct-fired kilns, and claim advantages for this method in flexibility, heating-up times, and control of the firing cycle.

687. Jones, A. Tonind. Ztg. 56,755-6,780-1(1932)
Design and operation: air regulation and heat supply; utilization of waste heat from steam engines.

688. Junck, G. Chem. Eng. and Min. Rev. (Melbourne), 23, no. 265, Oct. 1930, pp. 40-42
DRYING AND BURNING OF CLAY WARE. Drying behaviour of clays; burning of clays; steaming or water-smoking; oxidation; soaking period; cooling period. Abstract of paper read before Soc. Chem. Industry, Victoria.

689. Knapp, E. W. Brick and Clay Rec. 85 n 4 Oct. 1934. p. 122-3 and 136
WHEN IS CLAY PRODUCT "BONE DRY"?. Discussion of conduits, laminating clay and de-aired ware.

690. Kochler, W. A. Trans. Amer. Inst. Chem. Engrs. 40. 585-9. 194
APPLICATION OF UNIT OPERATIONS IN THE CERAMIC INDUSTRY - DRYING.
A general discussion of the general methods of drying ceramics.

691. Krause, J. Sprechsaal. 83, 15, 291-2. 5 Aug. 1950. 16, 309-312, 20 Aug. 1950
SOME OBSERVATIONS ON THE DRYING AND FIRING OF CLAY PRODUCTS.

692. Laurin, F. Ind. Ceram (Ed. B. Rev. Matèriaux de Construction) No. 382, 6-8, 383, 24-6 No. 385, 78-80, 386, 99-101, 384, 51-3, No. 388, 146-50, No. 389/90, 183-4, 1948
A REVIEW OF THEORY AND PRACTICE. Types of dryers and control equipment are described.

[illegible]. Laurin, F. Industr.Ceram.,No.386,99, 1948.
THE DRYING OF CERAMIC PRODUCTS. III. It is pointed out that a dryer should be designed to handle ware of a definite moisture content, and this factor in the making process should then be kept constant. The temperature of the ware entering the dryer may vary very considerably at different seasons, and this variation should be allowed for. Ancillary equipment in the drying section of a factory includes hygrometers and temperature-measuring devices; these are briefly discussed. The available types of fan and methods of calculating the capacity required are outlined. (1 table.)

694. Laurin, F. Industr.Ceram., 1948, No.388,146,Brit. Ceram.Abstr.,1949, 84A).
DRYING OF CERAMIC PRODUCTS. Recovery of heat lost from the exterior of a kiln is difficult; recuperation is effected more readily in the case of waste gases. Examples are given of the method of calculating the heat requirements of dryers.

695. Lipinski, F. Keramische Rundschau,44,No.44,Oct.29,1936 p.523-5.
DRYING OF CERAMIC MOLDS. Discussion of different drying systems; recommendations for improvement of natural drying processes.

696. Lipinski, F. Tonindustrie-Ztg.60. No.89. Nov.5,1936 p.1096-8.
DRYING OF CERAMIC PRODUCTS. Limitations of open air drying and advantages of artificial drying, discussed; recommendations made.

697. Lovejoy, E. Clayworker,98.100-2,140-1 1932,99,23-5, 64-5,1933.
FUNDAMENTALS AND ECONOMICS IN CLAY INDUSTRIES. A series of papers dealing with general aspects of clay drying, and drying equipment. for various products.

[illegible]. Macey, H. H. Br.Ceramic.Research Assn.Rep.March,1935
INSTRUMENTS OF VALUE IN THE DRYING OF CLAY. A review is given of the temperature and humidity instruments which may be used in the drying of clay. Classified as indicators or control instruments.

699. Macey, H. H. et al. Trans.Brit.Ceram.Soc.,46,207,1947.
THE DRYING OF CLAYWARE - A DISCUSSION. The discussion covers the following major topics: types of dryer, their design and efficiency; the construction of hot-floor dryers, and their operation in the drying of silica and siliceous refractories and of large sillimanite blocks; the effect of air velocity and the use of hot air from kilns; the cost of infra-red drying. Other factors bearing on the general problem of drying clayware are also briefly considered.

700. Marbaker, E. E. Amer. Ceram. Soc. 1948, Bull. 27, 277-9 Chem. Abstr. 42, 7502, 1948.
CONFERENCE ON HIGH TEMP. CERAMICS.

701. Matzen, H. B. and Parmelee, C. E. J. Am. Ceram. Soc. 13, 856, (1930)
CLAY DRYING -- AIR CONDITIONING.

702. Meierhagen, L. Keramische Rundschau (Berlin), 3, no. 45, Nov. 6, 1930, pp. 680-681, 3 figs.
ARTIFICIAL DRYING IN THE CERAMIC INDUSTRY. Modern procedure in drying of ceramic ware.

703. Netzel, G. and Fischer, R. Ber. der Deutschen Keramischen Gesellschaft 17, n, 4, Apr. 1936, p. 210-
CONTRIBUTION TO THEORY AND PRACTICE OF CONTINUOUS FILTRATION AND DRYING OF CERAMIC RAW MATERIALS AND BODIES. Illustrations of vari types of filters.

704. Mitchell, L. A. Trans. Ceram. Soc. 31, 288-92 (1932).
COMBINED DRYING AND FILTRATION-CONTINUOUS DRYING OF POTTERY.

705. Philipp, O. Tonindustrie-Ztg. 58, 134-6, (1934), Feb. 5.
NEW HUMIDITY DRYING METHOD FOR HEAVY CLAY INDUSTRY; DATA ON NEW METHODS.

707. Robinson, R. R. Bull. Amer. Ceram. Soc., 20, 309, 1941.
PRACTICAL APPLICATION OF AUTOMATIC HEAT AND HUMIDITY CONTROLS TO DRYERS. In continuous tunnel dryers, it is assumed that the constant evaporation of water will humidify the air as the ceramic ware absorbs heat and that the relative humidity of the air will increase as it flows towards the cooler end of the tunnels. The air, however, neither flows in uniform quantities nor with uniform entering temperatures, nor does the ware pass continuously through the tunnels. By placing a fan at the cool end of a tunnel dryer a thereby passing the drier air through a duct system to the centre o the tunnels, uniform relative humidity may be maintained at various stages to the point of saturation. When the temperature in the cooler end of the dryer increases beyond the desirable point, a small propeller fan is used to introduce cooler air from the atmosphere.

708. Robinson, R. R. Ceram. Age, 52, 66, 1948).
DRYING CERAMIC WARES. Use of heat energy has been, and remains, the accepted method of drying ceramic wares; electrical energy, as such, is too costly, and mechanical energy is impracticable. The type of dryer to be used is influenced by certain variables; the effect of changes in atmospheric conditions is discussed. Changing air flow is a complicating factor: evaporation varies with the flow of air, and the capacity of the atmosphere to take up water vapour from the ware can vary between the ratio of 1.6 to 1 in winter and summer. No details of dryers are given.

709. Robson, J. T. JL. Am. Cer. Soc., 14, No. 10, Oct. 1931, p. 709.
Condensation on ware in dryer and subsequent drying disintegrates clay as does slaking in a clay bank. Discussion of "blistering". Typical drying schedules.

710. Rochelberg, C. Sprechsaal, 83, 6, 106-7, 20 March 1950.
DRYING INSTALLATION AND FUEL ECONOMY. Illustrated description.

711. Rowden, E. Trans. Brit. Ceramic. Soc. 47, 9, 327, 9/1948
POWER IN RELATION TO PROCESS REQUIREMENTS IN HEAVY CLAY AND REFRACTORIES INDUSTRIES. 23 pp. showing, with tables, comparisons in the turn-over from one fuel to another for power and drying purposes. Useful information on drying in relation to the use of various power sources.

712. Schmidt, C. Tonind. Ztg. 65, 461, 487, 1941.
THE HEATING AND OPERATION PROBLEMS IN ARTIFICIAL DRYERS. A chart shews the heat input and air requirements for a theoretical dryer. The influence of atmospheric conditions is discussed. Rapid drying requires less heat input. Heat losses from chamber dryers amount to 15-30%. 2/3rds of heat can be obtained from waste heat sources, but tunnel dryers can be operated entirely on waste heat. Intermediate heating of air can be adopted for chamber dryers, to reduce initial temperature of air, but not recommended for tunnel dryers.

713. Shvartser, R. A. Ogneupory, 9, 90, 1941.
STUDY OF THE "TRANSPORTABILITY" OF SILICA COKE-OVEN SHAPES BEFORE DRYING. Large silica shapes must be dried on hot-floor dryers mainly because they are too fragile to withstand transport on cars through a tunnel dryer. The author outlines the disadvantages of hot-floor drying and describes a test in which silica shapes, after standing for varying periods after forming, were placed at various heights on a car and moved along a rail track, with two reversals on turntables. Shapes weighing from 27 to 80 lb., made from a batch containing 9% of water and 2.6-2.9% of lime, were tested after standing 3-12 hr. at 18^{0}C. Simple shapes could be safely transported, without cracking or squatting, after standing for 3 hours after forming. Larger complex shapes required 6-8 hr.

714. Sibson, W. Ceramic, Age, 19, 214-7(1932) May.
DRYING CLAY WARES.

715. Sibson, W. Brick and Clay Rec., 78, no.9, May 5, 193
pp.495-496, 2 figs.
DRYING CHARACTERISTICS OF CLAY - THEIR EFFECT ON DRYER DESIGN. Drying cycle may be divided into two parts, namely, period made u of three stages and post-shrinkage period of one stage; chart illustrates drying cycle; surface shrinkage; design and construction of modern drying equipment.

716. Simpson, T. Trans. Ceram. Soc. 33, 85-91, (1934) Mar.
RAPID DRYING OF GENERAL EARTHENWARE.

717. Spingler, K. Tonind. Ztg. 66, (68), 1942.
OPERATIONAL EXPERIENCES WITH A CHAMBER DRYING PLANT.

718. Spurrier, H. Ceramic. Industry, 16, No. 5, May 1931,
pp.447-448 and 451-452, 6 figs.
SOLVING DRYING CHARACTERISTICS OF CLAY. Device was worked out o indicating type based largely on plan of steam-engine indicator; in its improved form it was used to secure data from which curves shown are plotted.

719. Stacey, A. E. Jr., J. Am. Ceramic. Soc. 8, 525 (1925)
Matzen, H. B.
CERAMIC DRYING AND DRIERS. Description of several dryer types where air circulation is poor. Carrier ejector principle. Discussion of temperature and humidity control. Plot of typical drying schedule for clay. Clay dried to 2 to 6% water, lower if rapid firing in kiln.

720. Tives, T. H. Keramische Rundschau, 42 n 43,
Oct. 25, 1934, p. 536-8.
DIE TROCKNUNG IN DER FEINKERAMIK. Drying in fine ceramics; phenomena occurring with drying; properly conducted drying proces design and operation of driers.

721. Twells, R. Am. Cer. Soc. Bul. 15 n 9 Sept. 1936, p. 311-
SPRAY-DRYING PROCESS: SOME POSSIBLE APPLICATIONS TO CERAMICS. Brief review of various methods. Bibliography..

722. Vasel, A. Keramische Rundschau, 43 n 24, June 13,
1935, P. 278-9.
Investigation of drying of molded ceramic products; cause of strain and cracks occurring during drying, and means of prevention briefly discussed.

723. Westman, A. E. R. and Mills, R. G. J.A.Cer.S., 12, 162, (1929)
WASTE HEAT DRYER CALC. AND CHARTS.

724. Wettig, E. Tonindustrie.Ztg. 59 n 24, Mar. 21, 1935, p.302-4.
DRYING OF STONEWARE PIPES. Study of effect of temperature, air movement and air moisture; drying in warm air with insufficient ventilation produces cracks, and stresses occur in interior of pipes; drying at lower temperatures, moving air, and high moisture content do not injure ware, but it requires longer time for drying; best results obtained when drying at higher temperature with good ventilation and low moisture.

725. Wilson, H., Page, G. A. Cartwright, V. S. Cer.Age, 25 n 5 and 6 May, 1935, p.157-60 and June p.202-3, and 210 and 26 n 1 and 2 July, p.13-6 and 38-9 and Aug. p.54-7.
DEWATERING CLAY SUSPENSION BY SPRAY EVAPORATION. Previously indexed from U.S. Bur Mines -- Report Investigations n 3248 Jan. 1935.

726. Whitaker, L. R. Brick, 96, (6), 30, 1940.
DRYING TROUBLES. 7. The problem of humidity is discussed and the operating principle of humidity dryers is described.

Additives, Effects Of

727. Budnikoff, P. P., Kukolew, G. W. and Mandelgruen, E. L. Tonindustrie-Zeitung, 55 No. 28, Apr. 6, 1931, pp. 409-411, 1 fig.
ACCELERATED DRYING OF CERAMIC PRODUCTS. Three methods of accelerating drying process are listed, namely, introduction of shortening agents, thermal treatment of clay, and admixture of materials which coagulate clay particles; study of influence of different electrolytes on drying speed.

728. ——— Canad. Dept. Mines, Mines Branch Report. 722, 46, 56, 1931.
CLAY DRYING: DEFECTS OVERCOME. Results of adding small amounts of Ferric Chloride and Sodium Chloride to clay.

729. Davis, N. B. Trans. Amer. Ceram. Soc. 17, 497, 1915.
EFFECT OF SOLUBLE SALTS ON DRYING OF CLAYS.

730. Henry, E. C. and Siefert, A. C. J. Amr. Cer. Soc. 24, 281, 1941.
PLASTIC AND DRYING PROPERTIES OF CERTAIN CLAYS AS INFLUENCED BY ELECTROLYTE CONTENT. The plasticity and drying properties of two clays saturated with certain electrolytes are measured by the Gareis-Endell machine, Comparison of various clays. The drying shrinkage using petrol in place of water as the tempering liquid

was examined and the porosities are given. The addition of 10 m.e Na_2 Co_3 reduced the porosity from 39.4% to 31.2% and further additio increased it to 35%.

731. Macey, H. H. Cer. Soc.--Trans. 34 No. 9 Sept. 1935, p. 396-
S. C. I. Meeting April 1935.
PROMOTION OF DRYING OF CLAY BY COAGULATING EFFECT OF ACID. Effect of hydrochloric acid on cracking; cracking experiments; relative coagulative power of other electrolytes; effect of acid on other properties of clay. Bibliography.

732. Schurecht, H. G. J. Amer. Ceram. Soc. 25, 422, 1942.
McMahon, J. F.
TESTING AND IMPROVING THE DRYING BEHAVIOUR OF CLAYS. A simple test has been developed to measure the drying behaviour of clays, by noting the relative rate of flow of water through the clays as compared with the rate of evaporation from the surface. The addition of 0.2% of various chemicals to clays improved their drying properties. No one chemical was best for all of the clays, but the most effective chemicals varied in their reaction on different clays Iron chloride exerted a beneficial effect on most of the clays. A wetting agent, such as NaCI, HCl or soda ash, also improved the drying properties of certain clays.

733. Stanley, H. F. Trans. Amer. Ceram. Soc. 17, 697, 1915.
EFFECT OF SOLUBLE SALTS ON DRYING OF CLAYS.

734. Sullivan, J. D. and Graham, R. P. J. Amer. Chem. Soc. 23, 53, 1940.
EFFECT OF EXCHANGEABLE BASES ON THE DRYING OF CLAY BODIES. Studies at various temperatures and humidities of Hydrogen, Calcium and Sodium clays. Two stages of drying are distinguished. 1. with shrinkage and 2. Slower and only slight shrinkage. Influences of the additives on these.

735. Wolfram, H. G. Am. Enameler, 4, 1931. (3). 14, 24. (4), 6-9
Chimie et Ind. 26, 1939.
THE EFFECT OF MAGNESIUM CARBONATE AND BORAX ON THE TIME OF DRYING.

China Clay

736. Anon. Chem. Age, 1946, 55, 593.
HEAT FOR DRYING. China clay requires a special drying technique. The process is wet in the early stages, and dewatering proceeds by gravity or pressure filtration until the point where heat is applie to obtain the required dryness. About 85% of total output is drie to 10% moisture content, and 15% is dried to 1% moisture content fo disintegration and bagging as powder. Fine particle size and the need to avoid calcination impose limitations on the methods which can be adopted. The usual method is to settle clay from a slurry to a semi-plastic state in tanks alongside a drying floor composed of porous firebrick tiles laid on flues which are heated by coking-type furnaces. The flues are long enough to reduce gas temperature

to 110°C. The clay is laid on the floor and evaporation takes place partly above the bed and partly in the flue by seepage of moisture through the tiles. The filter press reduces the moisture content to 30%, and the time of settling by several weeks.

737. Beach, D. D. Ceram. Age, 40, No. 6, 176, 1942
DRYING PROCESSES WITH GAS HEAT. Two methods of lowering the relative humidity of air are described, and infra-red or radiant drying is discussed. A historical review is given of the drying of kaolin. Where moisture contents as low as 1% are required, the clay is often pulverised and dried in an impact or roller mill with air, heated in a direct fired air heater, supplied at the bottom of the mill; the drying is completed as the minute particles of clay are carried upwards to the separator. Replacement of the boiler and steam coils with direct gas-fired heaters in tunnel dryers is suggested. In a new installation it is intended to spray clay, in about the consistency of milk, through nozzles in the roof of a spray dryer. As this slurry is atomised, heated air furnished by a direct gas-fired heater and mixed with stack gases from a 400-h.p. gas-fired boiler will instantly dry the clay. Another process mentioned is that of intimately mixing super-heated steam, produced in a gas-fired boiler and separately gas-fired superheater, with pulverised clay.

738. Clegg, L., Jackson, S. V. Inst. of Fuel. "Drying Study" March'51.
CHINA CLAY. THE DRYING OF PASTES, POWDERS AND CRYSTALS. Drying of the shredded clay on a Buell turbo dryer. Tabulated summaries of drying tests.

739. Love, C. R. Fuel and the Future pp.290-2, 1948
THE DRYING OF CHINA CLAY. A general description of hot floor drying. Not adequate for drying to 1%, moisture. Describes attempts to find a rotating kiln which would dry quickly but avoid calcining. Application of turbo-dryer. This is shewn to be the most economical in power consumption (combined moisture is lost at 400OF.) 35-40% fuel saving is possible by the turbo-dryer.

740. Kamei, S., Mizuno, S. Soc. Chem. Industry, Japan-J. 37 No. 12
Shiomi, S. Dec. 1934, p. 1627-35.
INVESTIGATIONS ON DRYING OF SOLIDS. Relation between rate of drying and nature of liquids contained in kaolin. See also German abstract in supp. binding of same issue p. 756-64B.

High Frequency Heating

741. Kohler, C. J. Ceramic Industry, 57, 3, 55, Sept. 1951
DRYING CERAMICS BY ELECTRONICS. Experimental comparisons with conventional methods and recommendations made.

742. Bodin, V. Industr.Céram., No. 392, 229, 1948.
DRYING CERAMICS BY HIGH-FREQUENCY CURRENT. Experiments were carried out with grogged firebricks, roofing tiles, building bricks and porcelain plates and their moulds. The firebricks dried in 35 min., and no cracks were visible. However, comparison with similar bricks dried in the conventional manner showed that these had a close textur whereas the bricks dried by H.F. current had numerous cracks, probabl due to the rapid evaporation of water vapour. The building bricks, of sandy clay, cracked after 5 min.; it was estimated that 4 hr. at least would be necessary to dry them. The tiles, which were 12 mm. thick, dried in $2\frac{1}{4}$hr. The last two runs with a plate and its mould required 1 hr. only. The plate did not warp and the mould stood up well to drying. This represented a considerable reduction in drying time. (12 figs.)

743. Harrell, D. Brick, Clay Rec., 108, No. 2, 46, 1946
ELECTRONIC HEATING AND THE CERAMIC INDUSTRY. It was discovered from tests carried out that approximately the same results were obtained when a standard clay body was heated in an electric oven as when it was heated by a radio-frequency heater. It was found through investigation that 360 gm. of a black clay in slip form with 440 gm. of water could be heated from 32^0 to 89^0C. with an input power of 253 watts. A test was carried out on the possibility of drying wet clays electronically. A heater was arranged to heat a $\frac{1}{4}$-in. x2-in. column of wet black clay with 18% moisture. It was found that by using power up to and including 1 K.W., this column could be heated from 30^0 to 100^0C. at the rate of 1 ft. per min., using frequencies of 6 megacycles and injecting an air column between the clay and the upper conducting plate. The advantages of dielectric heating are listed.

744. Martin, H. J. Electrotechnik, 4, (9), 314, Sept. 1950
DIELECTRIC DRYING OF PLASTIC CLAYS. (Transl.) Advantages and disadvantages are discussed.

745. Morgan, J. P. Ceram. Age, 49, 60, 1947.
POSSIBILITIES OF DIELECTRIC HEATING IN THE CERAMIC INDUSTRIES. In the light of present knowledge, dielectric heating can only be applied to ceramics for the temperature range 100^0-150^0C. in which free moisture is driven off. Dielectric heating is carried on at high voltage impressed on two plates, usually parallel, between which the material to be heated is placed. No heat is developed in the plates. The power to produce the heating is obtained from a vacuum tube oscillator which holds a frequency at a desired level, and the alternating current of the power line is converted to direct current for the oscillator. This power source may be connected to the electrodes directly and form part of the "tank" capacitance, or may be connected by means of a co-axial transmission line. Formalae for the power to provide heating and to determine power losses are given. The dielectric constant of water is 80, and that of air is 1, and most materials range between these two figures;

considerable moisture content will raise the constant of a material appreciably. The three main limitations in dielectric heating are voltage capacitance and dielectric loss factor. The maximum allowable voltage per unit height of material is dictated by the vacuum tube and is of the order of 15,000. Usually an air gap has to be provided between the upper electrode and the work, to allow evaporation of water vapour without recondensation on the electrodes, and to prevent heat loss to the electrode by conduction.

Infra-Red Heating

746. Anon. Ceram. Age, 46, 108, 1945

INFRA-RED DRYING AT BUFFALO POTTERY. Infra-red equipment reduces the time required for drying vitrified hotel ware, and also the warpage, but the best results are obtained when it is supplemented by hot air. Surface moisture does not affect the results, but dark colours absorb the heat more rapidly. The cost is stated to be reasonable.

747. Anon. Mass Prod., 1947, 23, No. 4, 51

GAS - INFRA-RED. Fireclay radiants for gas-fires were dried in 4 hours by the use of a simple infra-red dryer.

48. Anon. Ceram. Ind., 41, No. 3, 28, 1943

NEAR INFRA-RED: WHAT IT IS AND WHERE YOU CAN USE IT. The "near infra-red" rays have a wavelength of 7,800-28,000A; the sources used emit maximum energy between 11,000 and 14,000A. The chief advantages of infra-red heating are the speed with which the exposed surface is heated and the simplicity and economy of the equipment. The importance of the reflector design is stressed; the reflector may either be integral with the lamp or a separate unit. In the ceramic industry, infra-red lamps are being used in America to dry on-glaze colours, to dry glaze on vitrified china, etc. In these processes the coat to be dried is very thin and drying is complete within a few minutes. Gas infra-red burner cups are also described; these have been used successfully for firing kilns.

749. Anon. Ceram. Ind., 44, No. 3, 48, 1945

SAVING TIME WITH INFRA-RED IN CERAMIC DRYING. A radiant drying system has been installed at an American pottery eliminating the regular steam dryers. The old boiler is replaced by a waste-heat boiler heated from the flue gases of one of the continuous kilns. The infra-red drying system at another pottery has achieved savings in both time and space.

750. Anon. Gas, June 1946, 22, 40-42

NEW GAS-FIRED PRODUCTION LINE DRYER SAVES TIME, MONEY, LABOUR, FOR SOUTHERN CALIFORNIA POTTERY MANUFACTURER. Extensive research on two continents has resulted in the development of a radically new type gas-fired black panel radiant dryer which enables ceramic ware to b dried on a production line basis. At the present time, Vernon Kilns, Vernon, California, has the first of these new gas dryers installed and in operation. This new drying equipment has several unique advantages: 1. Production-line drying, 2. Saves plant floor space, 3. Cuts breakage due to handling, 4. Conserves storage space devoted to moulds and drying rooms, 5. Cuts drying time cycle, 6. Number of moulds needed is only one-sixth needed formerly, and 7. Low operational cost.

751. Atkins, F. L. Gas J., 244, 371, 402, 1944
INFRA-RED DRYING. A series of tests was carried out on the drying of small ceramic articles about 3 in. long by $\frac{3}{4}$ in. diameter. These articles are usually dried in 5 hours by electrically heated air, blown counter-current to their passage through a conveyor type stove, thus producing a high humidity condition at the initial dryin stage. Controlled humidity of this type has been accepted hitherto as the correct method of drying clays, thus avoiding the "case-hardening" effect. It was found possible to dry satisfactorily the articles mentioned above in less than $\frac{1}{2}$ hour in the infra-red tunnel

752. Bieler, G. Verre Silicates Industr., 13, 211, 1948
DRYING CERAMIC MATERIALS BY INFRA-RED. For infra-red drying the most valuable wave-lengths lie in the range 12,000-16,000 A. Gas radiants can release 99% of their energy in wave-lengths in this range, whereas tungsten filament lamps can produce only about 73%. The following heat reflection data are quoted for a pure kaolin:

Water content (%)	9	7	5	2	0
Reflectivity (%)	29	30	33	50	72

The amount of heat absorbed depends also on the colour of the ware, black reflecting only 2-13% of the heat whereas white reflects up to 90%. Published information on the experience so far gained in the application of infra-red drying in the ceramic industry is reviewed.

753. Bullock, C. L. Brick and Clay Rec. 108 50. May 1946
INFRA-RED DRYING IN THE CERAMIC INDUSTRY. Abstract.

754. Déribéré, M. Industr. Céram., No. 393, 259, 1948
THE APPLICATION OF INFRA-RED DRYING IN THE CERAMIC INDUSTRY. Infra red lamps are of two main types: spherical and parabolic. These have different focusing effects. The emission from these lamps is chiefly in the region of 12,000 A, that is, in the near infra-red. The relationship between the lay-out of the lamps and the intensity of irradiation is discussed. The times for 90% drying of test-pieces of various thicknesses were as follows:

Thickness of test-piece (mm.)	Time to remove 90% of water (hr.)
20-25	1
30-35	1¾
50	4¾
100	6¾

A photograph shows an infra-red tunnel dryer with 53 lamps each of 250-W. drying plates on the moulds at a French factory. (10 figs.)

755. Gould, R.E., Evans, B.B., Flannigan, A.M. Bull. Amer. Ceram. Soc., 24, 62, 1945
USE OF INFRA-RED IN DRYING POTTERY. Continuous or periodic drying stoves of the normal type will take 90-150 minutes to dry flat-ware, and it is calculated on this basis that 150-200 dozen moulds would be required to feed an automatic jigger using this method of drying. Mould cost and storage therefore becomes almost prohibitive to the use of the automatic jigger, but it is shown that this need not be if the drying time could be reduced to 15 minutes; this quick drying would reduce the number of moulds required for any given item to approximately 25 dozen. It was decided that the only possible method of achieving this quick drying would be by infra-red equipment. Laboratory experts confirmed this view, and the trials were gradually extended until a continuous infra-red dryer capable of drying about 25 dozen per hour was developed. This proved sufficiently successful to warrant the construction of a continuous infra-red dryer capable of handling the production of an automatic jigger. Several months' use has proved the success of the method, and the following conclusions have been reached. Only 12-15 minutes are needed to dry the average hotel china plate hard enough to be removed from the mould without fear of distortion.

756. Grossman, R. B. Ind. Heating, 14, 805, 1947
DRYING OVENS WITH LOW TEMPERATURE RADIANT PANELS. As the result of an article published in 1945, a number of dinnerware manufacturers in southern California became interested in the speeding up of their drying processes by electric infra-red lamps. British practice suggested that low-temperature radiant panels using gas would be more suitable, and the Automatic Control and Equipment Co., in co-operation with Vernon Kilns, constructed an experimental unit for drying dishes on plaster moulds. These moulds will stand not more than about 60°C. if destruction is to be avoided, and the ware requires uniform drying. It was determined that the clay could be dried in 20-25 minutes when placed under a 375°C. panel at a distance of 8-10 in.

757. Hayman, R. F. Fuel and the Future, Ministry of Fuel a
Power 1 p.258
OBSERVATIONS ON THE DRYING OF CERAMICS. 1½ inch is the maximum total thickness of any clay shape that can be dried economically b radiant heat without cracking.

758. Hepner, L. H. Bull. Amer. Ceram. Soc. 24, 415,-417, 1945
DRYING CLAYWARE WITH INFRA-RED RADIATION. Infra-red radiation ha been found suitable for the drying of heavy ware with a wall thickness of 1inch, provided that the radiation impinges on one surface of each wall. The equipment consists of 250-watt, 110-volt, drying lamps on a light, movable frame; the cost is stated to be low The drying time was reduced from an average of 12 days to a convenient 12-hour cycle, the 2-days' air drying in the casting shop being omitted. The plastic deformation and warping were decreased by the rapidity of the drying, and no other defects were introduced.

759. Hess, G. A. Ceram. Age, 39(1)8, 1942
RADIANT HEAT IN POTTERY DRYING. Apparatus is described. Advantages include higher overall efficiency. Tests on heavy sanitary ware and arrangement. Time reduced by 20 to 1. Plasticised dinner ware dried in 20 minutes at an optimum distance from lamps. Time shortened so as to increase operating cycle by at least 8: to 1. Electrical porcelain dried satisfactorily. Conclusion that with I.R. the drying time is 1/3 that of a "humidity dryer".

760. Hoare, H. Cer. Ind. 46 54 May 1946
INCORPORATION OF AN INFRA-RED DRYER INTO A CONTINUOUS CASTING SYSTEM.

761. Johnson, J. A. Brit. Pat., 586,358, 17/3/47
IMPROVEMENTS IN AND RELATING TO THE DRYING OF CLAY-WARE AND OTHER GOODS. In a method of drying clay-ware and other goods the pieces to be dried are placed in close proximity to heated drying elements, the contours of which correspond to the outline of the pieces. These are interposed between the pieces and their sources of heat, so that there is a confined and localised radiation of heat from the contours on to the pieces. (3 figs.)

762. Krupp, P. H. Elect. World 125 96, 30 Mar. 1946
INFRA-RED DRIES POTTERY BEFORE FIRING.

763. Macadam, A. C. F. Claycraft, 21, 417, 1948
THE APPLICATION OF INFRA-RED TO THE DRYING OF CERAMICS. The scope of infra-red drying in relation to wave-lengths, temperatures and drying times is considered. Wave-lengths of infra-red rays used in commercial drying are: electric, 7,700 to 40,000 A, the peak

being 12,000 A; gas-fired 20,000 to 150,000 A, with an extended peak from 40,000 to 60,000 A in the black emitter range. Gas-fired units usually operate at a peak of 46,000 A, corresponding to 340^0C., giving a flux density of 4,000 B.Th.U/hr/sq. ft. of surface falling on both sides of the article. A table gives total black body radiant heat emission/sq.ft/hr. in B.Th.U. and watts. From 1 to 1¼ in. is the maximum thickness which can be dried economically without cracking or warping. Two systems now used are dealt with, the gas-fired black emitter units and the electric dull emitter, in which most clay drying is carried out between 230^0 and 345^0C., although in some equipment it can range between 540 and 980^0C., the standard measurement of radiant intensity, or flux density, being 1 W/sq. in. (491 B.Th.U/sq.ft/hr.). Gas-fired units are of two types, the tunnel and the flat panel. In the tunnel 340^0C. can be reached in 40-50 minutes from starting. The flat panel type, usually built in box-like formation, is suitable for irregularly shaped articles. Operating details of the larger sizes are given as: radiating surface, 4.5 sq. ft.; gas rate per unit, 0.25 therms/hr.; panel temperature, 340^0C.; calorific value of gas, 500 B.Th.U/cu. ft. Net efficiency of the units is 50-55% of the total calorific value of the gas. Comparative drying times given show that an insulator of 23 oz. "wet" weight dried in 1½ hour compared with 3 days by convection, and similarly a thread guide of 31.7 g. took 10-11 minutes compared with 1 day.

64. Martin, R. Ceram. Ind., 47, No. 1, 70, 1946
NEW GAS-FIRED PRODUCTION LINE DRYER. A gas-fired radiant black panel dryer recently installed in a Californian ceramic plant is described and illustrated. Its dimensions are 46 ft. long, 6 ft. 5 in. wide, and approximately 8 ft. 8 in. high. It consists of four main components: a woven-wire conveyor, the black panel radiant drying section, a convection drying section, and a mould-return conveyor. The radiant drying panel is approximately 20 ft. long and 4 ft. wide, and the burners are situated above this, giving panel temperatures which can be regulated between 150 and 450^0C. The drying cycle is of 15-20 minutes duration, and the dryer capacity is 65-80 dozen pieces of small ware per hour.

64a. Paleev, I. I. Steklo-i-Ceram. 7, 18-20, Mar. 1950
USE OF RADIANT HEAT FOR DRYING OF CERAMIC OBJECTS. Study of use of long wave radiation. The conclusions of American investigators concerning the existence of optimum wavelengths for drying are refuted. B.L.R.

65. Roberts, A. L., Long, R. Gas Res. Bd. Publ. No. 15. 1945
FIRST REPORT ON INFRA-RED HEATING. Contains an assessment of its possibilities for drying refractories.

766. Roberts, A. L. Refract.J., 21, 301, 301-313 1945
THE APPLICATION OF INFRA-RED RADIATION TO THE DRYING OF REFRACTORIES
Infra-red rays form by far the greater part of the radiation emitted by all hot bodies, even those which are incandescent; the intensity and wavelength distribution depend on the nature of the body and its surface, and its absolute temperature. The energy given off is proportional to the fourth power of the absolute temperature, so tha the heat transfer by radiation is much greater than by convection, and the rate of heating more rapid. If exposed on both sides they crack, as the moisture apparently travels away from the irradiated surface. Thin ware responds satisfactorily to the infra-red drying

767. Thompson, W. G. Gas, (Los Angeles), June, 1948, 24, (6), 36-39
GAS-FIRED DRIERS HELP BOOST CHINAWARE PRODUCTION. The gas-fired drying unit of the Wallace China Co., Vernon, California is describe It is 6 ft. wide and 60 ft. long. The moulds and wet ware are carried on a woven wire conveyor belt through a direct-fired radiant heat zone and then through the convection zone, which in turn is divided into two zones. The heat is released by combustion of pre-mixed gas and air in 66 Burdette radiant cup burners, each having a maximum capacity of 10 cu. ft. per hour of 1100-B.t.u. natural gas, located in the roof of the drier in a pattern which produces uniform heat distribution over the belt width. The radiant heat is absorbe mainly by the wet ware, as very little mould area is exposed. It raises the temperature of the ware quickly to the range at which evaporation of moisture is very rapid, but does not apparently induce any detrimental "case hardening" of the surface which would greatly retard evaporation. These burners operate at a dull glow, very slightly into the visible range, with the result that most of the radiation is in the true "infra-red" range.

768. Vindreau and Ardouin Industr. Ceram., No. 393, 262, 1948
THE DRYING OF HARD PORCELAIN BY INFRA-RED. Whereas the drying of green pottery in the plaster mould at 20°C. takes 2-4 days, and the drying in a heated chamber at 40°-50°C. takes 1 day, infra-red drying occupies only ½ hour. Laboratory experiments showed that, for smooth working, the temperature should be raised and the atmosphere in the dryer should be kept almost saturated. A laboratory dryer, operated under these conditions, had an efficiency of about 65%; an efficiency of 45% would be expected in an industrial dryer. The more rapid drying achieved by infra-red should reduce the number of moulds required 16-fold.

Fundamental Principles

769. ---- U.S. Bureau of Standards Technical Paper No. 1
DRYING OF CLAY. Data on Shrinkage rate etc. Discussion on size of capillaries, etc.

70. Various Authors J.Agric.Science Soil Science
Movement of water in soils and clays. See Section 1. Principles, under Fisher, Gardner, Haines Keen, Thomas.

71. Aren, J. ----- Notizblatt Zieg. 9, 176, 1873
Bischof, C. ---- Dingler's Jnl. 215, 130, 1875
Lines, E. F. --- Trans. Am. Ceram. Soc. 10 146, 1908
CONTRACTION OF CLÁYS DURING DRYING.

72. Berkman, A. S., Basin, E. V. Steklo-i-Keram. 6 No. 8, 17-20, 1949
DETERMINATION OF GAS PERMEABILITY OF POROUS CERAMIC MATERIALS. Apparatus is described for determining gas permeability at room temperature and at 300-350°C.

73. Bigot, M. A. Comptes Rendus 172 755-8, 1921
SHRINKAGE ON DRYING OF KAOLINS AND OTHER CLAYS. Results of experimental work on samples of a number of clays are described and presented graphically.

74. Broughton, D. B. Ind. Eng. Chem. 37 1184-5, 1945
Prediction of critical moisture content is discussed. Assumption of parabolic moisture gradient during constant rate period. An equation was derived relating average critical moisture with surface critical moisture, the thickness and density of material, the constant drying rate and the diff./coeff. of water in the solid.

75. Carpenter, J. L. Eng. Expt. Stn. News. 1948, Ohio State Univ. 20 No. 4
MODERN APPROACH TO DRYING PROBLEMS. Directed to avoiding shrinkage in clay-ware on drying. The approach classifies the possible methods of altering the physical properties of the clay or clay body, so that it may be dried safely at faster rates.

(a) Reduce amount of shrinkage by:-
  1. Adding non-plastic, as sand or grog.
  2. Treating clays with electrolyte.
  3. Preheating clay.
  4. Reducing initial amount of water by
    a. Working the body at higher temperatures.
    b. Change forming method e.g. from stiff mud extrusion to dry pressing.
    c. Using wetting agents.
    d. Using clays with less plasticity.

(b) Increase the green and dry strength by:-
  1. Binding agent as starch, flour, lignin, etc.
  2. Increase tempering of the clay body or improve clay by weathering or ageing.
  3. Grinding finer.

    4. Change from Plastic forming to Dry Pressing and so improve load resistance.
(c) Develop a more porous structure by:-
    1. Preheating of extremely plastic clay to give it a granular texture.
    2. Treating very sticky plastics with electrolyte.
    3. Controlling distribution of particle size.

Dryer conditions and dryer design.

776. Chesters, J. H., Weyl, W. Trans.Br.Ceram.Soc.32,201,1933
Drying of Clay ware. Deals with expansion of refractories on dryin due to accelerated hydration on heating.

777. Correnz, C. W., Schott, W. Kolloid-Zeit. 65 n 2 Nov.1933,
P.195-203
UEBER DEN EINFLUSS DES TROCKNENS AUF DIE KERNGROSSEN-VERTEILUNG VON TONEN.

778. Cronshaw, M. B. Br.Refractories(Ceramic)Res.Assn.
Bull.No.7 Aug.1924
DRYING. A collection of data to assist the manufacturer to work out the quickest rate of safe drying. Internal and external factor

779. Fisher, E. A. Proc.Roy.Soc.1923,A.103,139-161
SOME MOISTURE RELATIONS OF COLLOIDS. II. Further observations on the evaporation of water from wool and clay. Shrinkage is not demonstrated with wool fabrics, although the results do not rule it out.

780. Garve, T. W. Trans.Am.Cer.Soc.17,697(1915)
DILUENT EFFECT ON DRYING BEHAVIOUR OF PLASTIC CLAYS. Thesis, Ceramic Department, Ohio State University.

781. Gilliland, Sherwood
DRYING OF SOLIDS. See under Principles, Diffusion.

782. Grim, R. E., Bradley, W. F. Amer.Min.33(1 and 2)50,D.S.I.R. M.65 and
R.I./134
REHYDRATION AND DEHYDRATION OF THE CLAY MINERALS.

783. Hinchley, J. W. Trans.Inst.Chem.Engrs.6,128-130 Conf.
Dec.1928
DRYING BY PRESSURE. ELECTRO-OSMOSIS. It is claimed that 200-600 volts with possibly the addition of a peptiser, say, sodium silicate 0.01%, would reduce moisture to 28-20% in a few minutes.

784. Hind, S. R. J. Inst. of Fuel 24 137, 116-23, May 1951
DRYING IN THE POTTERY INDUSTRY. Review of methods used for drying. Economic aspects. The scientific factors involved in the process with particular reference to moisture/porosity relations. The limits set by the properties of the moulds and shrinkage of the ware, with graphical illustrations. Reference is made to high frequency and radiant heat drying, and the narrow application of these. The layout of factories and engineering aspects are considered and illustrated. A comprehensive table embodies the practical aspects of 9 types of dryer. Inst. of Fuel Drying Study. 1950-51

785. Hind, S. R., Degg, E. P. Br. Refract. (Ceramic) R. A. Bull. No. 28. Sept. 1931
TEMPERATURE EFFECT ON THE STRENGTH OF PLASTIC CLAY.

786. Hind, S. R., Macey, H. H. Br. Refr. (Ceramic) R. A. Bull. No. 27, 1932
A REVIEW OF THE MAIN CAUSES OF CRACKING OF CLAY IN THE GREEN STATE.

787. Hind, S. J., Wheeler, F. Trans. Br. Ceram, Soc. 29 314, 1930
THE EFFECT OF TEMPERATURE ON THE CRACKING OF PLASTIC CLAY, WITH SOME NOTES ON THE TEMPERATURE GRADIENTS. Inside the clay during steady heating in a saturated atmosphere, and on drying at 100°C. It is probable that clay can be safely dried above 100°C, when the moisture is reduced below 21.5%, by air drying.

789. Jackson, W., Rich, E. M. J. Soc. Chem. Ind. 19 1084, 1900
CONTRACTION OF CLAYS DURING DRYING.

790. Journier, E., Perrier, J. Comptes. rendus, 227 839-41, 1948
CONTRACTION ACCOMPANYING THE DRYING OF CERAMIC PASTES, AND AN APPARATUS SUITABLE FOR RECORDING THE BIGOT CURVE. Illustrated description of apparatus for automatic tracing of the Bigot contraction mass curves, (C.R. 172, 1921). The very different curves obtained with 3 brick clays (shewing effect of temperature, humidity, etc. on drying) indicate the possible application of the apparatus to the study of carbonisation of oils, chemical decomposition of plastic materials, absorption of gas by porous bodies.

791. Keler, E. K. Ogneuporu, 11, No. 7-8, 23, 1946
THE DETERMINATION OF REHEAT, SHRINKAGE AND EXPANSION OF REFRACTORI
Points to be studied in formulating an after-contraction test are: (1) the effect of the duration of the soaking temperature, (2) the method of measuring the change in length or volume, (3) the influe of the furnace atmosphere, (4) the type of furnace. In this pape the first two of these points are examined. Tests on fire-bricks and silica bricks indicate that a 3-hour soaking temperature would preferable to the present Russian Standard 2-hour test. In the c of chrome-magnesite bricks it was found that shrinkage continued d ing the fourth hour of soaking. The temperature of soaking must carefully selected on the basis of the usage in view. Recognisin the difficulties of linear measurement, tests were carried out on volume measurement. Immersion in mercury is less satisfactory th immersion in water, and tests showed that weighings in water vary very little with the time of immersion, even in the case of insulating bricks.

792. Ketchum, Westman, and Hursh Un. Ill. Eng. Exp. Sta., Circ. 14 1928
PERMEABILITY OF CERAMIC BODIES. Permeability of unburned clays o
$\frac{1}{100}$ to $\frac{1}{10,000}$ that for burned fire clay.

793. Laurin, F. Industr. Céram., No. 382, 6; No. 383, 24, 1948
THE DRYING OF CERAMIC PRODUCTS. The usual classification of clay according to the uses to which they are to be put is described. relationship between grain size, plasticity, proportion of impurities, etc., on drying is studied. Absorption and adsorptio are defined, and the mechanism of evaporation is described.

794. Lindsay, D. C., J. Am. Ceram. Soc. 8, 667(1925)
Wadleigh, W. H.
DRYING PROPERTIES OF CLAYS. Classes water as: (1) Water of plasticity (2) Shrinkage water (3) Pure water (4) Hydroscopic. Gives two drying curves with temperatures of clay body. Above "crit. air vel." internal diffusion controls. Ratio sq. cm. per gm. important, Common types of drying injuries are warping, breaking, large cracks, checking, cracking along lamination strain Warpage and most common in light wares. Drying must be slowed up until all shrinkage is finished - then speeded up. Gives curve o strength of Clay vs. H_2O content. Describes laboratory drying cabinet. Describes optical flexure balance.

795. Luikov, E. Trans. Cer. Soc. 35, 123-37 (1935)
CLAY DRYING. Moisture Content Gradients in the Drying of Clay and their effects on shrinkage and cracking.

796. Lynam, T. R., Tr.Br.Ceram.Soc.49(4)141-157 Apr.1950
Nicholson, A.
THE CRACKING OF SILICA PRODUCTS DURING MANUFACTURE. A survey of the probable causes has shewn that the major proportion of cracking is due to inefficient or insufficient drying or both. It occurs at places where maximum shrinkage strains occur.

797. MacEwan, D. M. C. J.Soc.Chem.& Ind.65,298,1946
CLAY/ORGANIC COMPOUNDS. Physical (molecular) relationships.

798. McCreight Amer.Cer.Soc.Bull.21 257-62 1948
PERMEABILITY DATA ON AMERICAN REFRACTORIES.

800. Macey, H. H. Br.Refractories-(Ceramic)R.A.Rep. Jan.1934
THE DRYING OF CLAY. V. THE INFLUENCE OF A METAL SHORD ON THE DRYING OF THIN SLABS. A 40% increase in rate of drying is obtained.

801. Macey, H. H. Trans.Ceram Soc.33 92-103,1934
THE PRINCIPLES UNDERLYING THE DRYING OF CLAY. Deals with rate of drying, shrinkage, prevention of cracking, mode of packing of the particles during drying. Drying practice.

802. Macey, H. H. Cer.Soc.--Trans.v 35 n 8 Aug.1936
Br. Ceramic R.A. p.379-87
SOME CONSIDERATIONS OF TIME FACTOR IN DRYING. Drying time for chamber and tunnel driers; time relations in drying under constant conditions; necessity for high temperature during latter stages of drying.

803. Macey, H. H. Br.Refract.(Ceramic)R.A.Rep.June 1936
NOTES ON THE DRYING OF CLAYWARES WITH SPECIAL REFERENCE TO HUMIDITY DRYING. The strains set up by temperature and moisture gradients are discussed.

804. Macey, H. H. Br.Refract.(Ceramic)R.A.Bull.No.39. Rep.213,1936
THE FLOW OF WATER THROUGH PLASTIC CLAY AND THE INTERNAL MECHANISM OF DRYING. An experimental method is described for measuring the aqueous conductivity of three clays. A colloidal theory is put forward to account for the pressure-moisture content relations of plastic clay. (Discussion and theoretical aspects in B.R.R.A. Bulletin No. 45, Report 252, February 1938. The theory of clay consolidation of Terzaghi is critically reviewed in B.R.R.A. Bulletin No. 62, Report 375, September 1941).

805. Macey, H. H. Trans.Br.Ceram.Soc.37 131,1938
THE DRYING OF CLAY. The influence of temperature and humidity on the rate of drying of thin slabs of a fireclay mix.

806. Macey, H. H. Trans.Br.Ceram.Soc.38 469,1939 B.R.R.A.
Br. Ceramic R.A. Bull,1935
THE DRYING OF CLAY. The safe drying of large fireclay blocks. The maturing of the moulded piece is definitely beneficial, althoug strict prevention of drying while maturing is unnecessary. For discussion on various shapes and sizes see same volume page 464.

807. Macey, H. H. Proc.Phys.Soc.52 625 1940
CLAY WATER RELATIONSHIPS. It is shewn that if a plastic mixture o clay and water is subjected to a steady pressure between porous pistons, the applied pressure P. is related to the moisture content M. by the expression:-
$P = a\,e^{B\,M}$, and the aqueous conductivity obeys a similar relation $C = \theta\,e^{\phi\,M}$. The water movement during drying is associated with the pressure, and the formulae for P & C can b extrapolated to moisture-contents below those possible experimentally. Viscosity and interfacial effects are discussed. See also B.R.R.A. Bulletin 45, 252, 1938.

808. Macey, H. H. Br.Refract.(Ceramic)R.A.Bull No.62,(375
Sept.1941
SOME OBSERVATIONS ON THE THEORY OF CLAY CONSOLIDATION. The basic differential equation governing the flow of water through clay is developed. Critical review of Terzaghi's theory of clay consolidation.

809. Macey, H. H. Proc.Phys.Soc.54 128,1942
A PROBLEM IN TWO DIMENSIONAL FLOW. A method of solving a particular case of the two - dimensional heat - flow equation is given and used to calculate the distribution of moisture content of a clay cylinder drying from its curved surface only. Comparison of results with experimental data.

810. Macey, H. H. Br.Refract.(Ceramic)R.A.
Bulletin Nos.44,49,1937-1939 Proc.Phys.
Soc.54 128,1942
THE INTERNAL MECHANISM OF DRYING. Part 1. The moisture gradient in a fireclay during drying. Part 2. A comparison of theoretica and experimental moisture content distributions in clay bars during drying. Part 3. The Calculation of Moisture content Distributio in Cylinders. Trans. Br. Ceramic Soc. 41, 73, 1942.

811. Macey, H. H. Soc. Chem. Industr., Symposium on
Br. Ceramic R.A. Shrinkage and Cracking of Cementive
Materials, 1947. Nature, 158 13.1946

THE CRACKING OF PLASTIC CLAY ARTICLES DURING DRYING. The relationship of moisture content and shrinkage of clay is considered. The structure of plastic clay and the thickness of the water films between the clay particles are studied. During drying, moisture-content gradients are set up, the difference in moisture content between any two points at the same time after the commencement of drying being directly proportional to the rate of drying. If this rate is too great, the article cracks. Experiments have shown that, irrespective of the rate of drying, cracking starts when the moisture content of the surface layer has dropped to within a certain small range. Above this moisture content the surface layer deforms plastically, and the critical moisture content is that at which the clay has hardened sufficiently to prevent similar deformation. (11 figs.)

812. Macey, H. H. Min. of Works, Nat. Brick Advisory Council
Br. Ceramic Res. Assn. H.M.S.O. 1950, 190 pp.

DRYING IN THE HEAVY CLAY INDUSTRIES. Chapters 1 to 9. Hygrometry and the Determination of Thermal Efficiency. Chapters 10-16. Dryers used in the heavy clay industry. Chapters 17-20. Survey of thermal efficiency in practice, 23 tables, 22 figures and hygrometric tables.

813. Macey, H. H. J. Inst. of Fuel 24, 137, 124-5, May 1951

THE DRYING OF HEAVY CLAY ARTICLES. The basic problems encountered in the drying of bricks, tiles and other heavy clay articles are briefly described. Thermal efficiencies and suitability are discussed, and the subordination of thermal efficiency to final properties is indicated. Inst. of Fuel. Drying Study. 1951.

814. Macey, H. H., Green, A. T. Br. Refract. (Ceramic) R.A. Bull. No. 36,
Rep. 192, 1935

THE DRYING OF CLAY. Bottom cracking in saggars due to uneven drying.

815. Macey, H. H., Hind, S. R. Br. Refractories (Ceramic) Res. Assn.
Bull. No. 26, April 1931

THE PRINCIPLES OF HUMIDITY DRYING AND THE CLASSIFICATION OF TUNNEL DRYERS FOR HEAVY CLAY GOODS.

816. Macey, H. H., Hind, S. R. Trans. Br. Ceram. Soc. 36. 433, 1937 B. R. R. A.
Br. Ceramic R.A. Bull. No. 28

AN EXPERIMENTAL DRYER FOR CLAYWARES. Describes the construction of a special dryer to accommodate clay blocks up to 2 cwt which can be weighed while undergoing tests. Arrangements are described for conditioning the drying air, and for controls.

817. Macey, H. H., Wilde, F. G. Br.Refract.(Ceramic)R.A.Bull.No.28,1932
Bull.No.42,1937 Bull.No.51,1939
THE DRYING OF CLAY. The relation between size and rate of drying. The relation between thickness and the greatest safe rate of drying of some fireclay blocks. Further experiments on the relations between the greatest safe rate of drying and dimensions of fireclay blocks.

818. Macey, H. H., Wilde, F. G. Trans.Ceram.Soc.38,331,1939
The Linear Shrinkage of Pugged Clays. Shrinkage parallel to the line of flow is found to be greater than that across.

819. Macey, H. H., Wilde, F. G. Br.Refract.(Ceramic)R.A.Bull.No.59,
Rep.344,63-76 1941
THE THERMAL EFFICIENCY OF A CHAMBER DRYER. Determination of heat balance and nature of heat losses.

820. Mellor, J. W. Trans.Ceram.Soc.32,455-471 Oct.1933
NOTES ON SHRINKAGE DURING DRYING. Includes a brief review of the movements of water in clay.

821. Murray, P., White, J. Trans.Br.Cer.Soc.48,187,1949
KINETICS OF THERMAL DEHYDRATION OF CLAYS.

822. Norton, F. H. J.Amer.Ceram.Soc.16,86(1933)
CONTRACTION OF CLAYS DURING DRYING.

823. Norton, F. H., and J.Amer.Ceram.Soc.,27,77,1944
Johnson, A. L.
FUNDAMENTAL STUDY OF CLAY: V. NATURE OF WATER FILM IN PLASTIC CLAY. Using a pure monodisperse system of kaolinite particles of known diameter and thickness, it has been possible to calculate with a fai degree of precision the thickness of the water film separating the particles and the variation in thickness of this film for different pressures. It has also been possible to calculate with considerabl certainty the force acting between two clay particles. This clean, monodisperse, fraction of kaolinite has the following characteristic (1) The particles average 0-32 micron in diameter and 0.04 micron in thickness. (2) The water-film thickness in the plastic condition averages 0.005 micron, or about 60 molecular layers. (3) Under conditions of permeable pressing, the thickness of the film varies inversely with the pressure up to 600 lb./sq.in., above which distortion of the particles occurs. (4) The actual force acting between two particles varies between 0.13 and 0.0006 dyne.

824. Oden, S. Trans.Farad.Soc.17,244-248,1921-2
NOTE ON THE HYGROSCOPICITY OF CLAY AND THE QUANTITY OF WATER ABSORBED PER SURFACE UNIT. Incl. data on clays and soils.

825/6. Newitt, D. M., Coleman, M. Instn. of Chemical Engineers. Paper. 6 Nov. 1951 Abstract in Ind. Chemist, 27, 323, 355-9, Dec. 1951

THE MECHANISM OF DRYING OF SOLIDS. The mechanism which controls the removal of water from clay is studied experimentally and the results are interpreted. It is shewn that capillary forces will not account for the observed phenomena and the action of osmotic forces is proposed in explanation. The method of measuring "suction potentials" is described and the results obtained from clays prepared by different methods are discussed. The mechanisms of the various stages of drying are postulated.

827. Reumann, F. Ton-Industrie-Ztg v 59 n 15 Feb. 18 1935 p. 190-1

ARTIFICIAL DRYING AND FRACTURES CAUSED BY IT. Charts are plotted showing effect of slow and rapid drying on clayware.

828. Rieke, R. and Gieth, J. Berichte der Deutschen Keramischen Gesellschaft, 12, No. 11, Nov. 1931, pp. 556-594, 13 figs.

OBSERVATIONS ON PHENOMENA WITH DRYING OF KAOLINS AND CLAYS. Pretreatment of raw materials; tests for simultaneous determination of shrinkage and water loss; determination of porosity; hygroscopicity and plasticity coefficient; summary of results. Bibliography.

829. Roberts, A. L. Inst. of Fuel. Drying Study. 1951

DRYING OF REFRACTORY MATERIALS. Typical rate curves and shrinkage data are presented and the precautions necessary to prevent cracking during the constant rate period of drying. Reference is made to the modern humidity dryer and to the possible use of radiant heating. See Journal Instruction Fuel, 24, 137, 126-8 May 1951.

830. Robson, J. T. Am. Ceramic Soc.-Jl., 14, No. 10. October 1931, pp. 709-715, 3 figs.

NOTES ON DRYING AND DRIER OPERATION. Resume comparing drying shrinkage with action of clay slaking in bank; drying of Missouri dry-press refractories in summer vs. winter and blistering and means of prevention; operation of three Harrop-type driers and ordinary waste-heat tunnel drier.

831. Sherwood, T. K. and Comings, E. W. Am. Inst. Chem. Engrs-Advance Paper mtg. Dec. 7-9 1932, 16 p. Ind. Eng. Chem. 25, 311-6, 1933

MECHANISM OF DRYING OF CLAYS. Definition and details; experimental technique and results; comparison of data with theoretical equations; chart showing theoretical rate curves from Newman equation. Bibliography.

832. Spurrier, H. Am. Ceramic Soc-J. v15, n 1 Jan., 1932 p. 84-6
AUTOMATIC DEVICE FOR PRODUCING CURVE COORDINATING SHRINKAGE AND DRYING LOSS. Apparatus automatically plots curve and coordinates shrinkage associated with drying loss at any point on curve; from such curves correct drying schedules may be developed; it may be used in drier to indicate correct drying performance and curves furnish valuable information as to drying peculiarities of bodies not usually available.

833. Stacey, A. E., Jr. J. Am. Ceram. Soc. 8, 457 (1925)
THEORY OF EVAPORATION. Quotes data of Carrier, Coffey and Horne, and Hinchley and Hinnes on rate of vaporization. Gives two rate curves for clay. Effects of air velocity and turbulence.

834. Steger Tonind. Ztg 50, 28, 1927
THEORY OF DRYING OF CLAY.

835. Straight, H. R. Chem. & Met. Eng. 40, 410-13 (1933)
THE USE OF DE-AIRING FOR CLAYS AND OTHER PLASTIC PRODUCTS. The theory of de-airing is discussed and a number of methods and the resulting improvements in the products are described. Application to products other than those of ceramic nature are enumerated.

836. Tamura, M.
EXPERIMENTAL RESEARCH IN HIGH TEMPERATURE DRYING. See under Fundamental Principles.

837. Troop, R. S., Wheeler, F. Trans. Br. Ceram. Soc. 26, 231, 239, 261, 1927
THE DRYING OF CLAY UNDER DEFINITE CONDITIONS. PARTS 1, 2 AND 3. A series of observations with results on the rate of drying of clay under various temperatures and R.H.s. Two stages of drying are evident from the data obtained.

838. Vassiliou, B, and White, J. Trans. Brit. Ceram. Soc., 47, 351, 1948
VAPOUR PRESSURE-CAPILLARITY RELATIONSHIPS IN CLAYS AND THEIR APPLICATION TO CERTAIN ASPECTS OF DRYING. The movement of moisture occurring in clay columns subjected to a temperature gradient has been studied, and it has been shown that the distributions obtained are consistent with the operation of an evaporation-condensation, or kinetically equivalent, process resulting in the setting up of a temporary equilibrium distribution at any stage determined by the vapour-pressure/moisture-content/temperature relationships for the particular clay. The curves obtained have been used to derive a relationship between r, the effective capillary radius, and W, the moisture content of the clay, and it has been shown from this relationship that what appears to be a reasonable estimate of the

surface area of the clay can be made. Vapour-pressure/moisture-content isotherms have also been constructed for the clays studied, and are found to be of the usual hyperbolic form. The application of the findings to certain problems associated with the drying of clays has also been investigated briefly and is discussed. (17 figs., 5 tables.) The movement of water is towards the cooler portion, and experiments are described with wet Kaolin in a column of Trays where a radiating surface above causes moisture to move downwards from one tray to the next etc. to a water reservoir into which the lower ends of the tubes project.

839. Westman, A. E. R. J. Am. Ceram. Soc. 15, 552-63 (1932)
THE EFFECT OF MECHANICAL PRESSURE ON THE IMBIBITIONAL AND DRYING PROPERTIES OF SOME CERAMIC CLAYS. Clay samples, in plastic condition, were held between water-permeable pistons, under pressures of 200-2000 lb. sq. in., in contact with water at atm. pressure until equil. was reached. The expressed water was removed before the pressure was released. The moisture content and drying shrinkage decreased with increased pressure; with some clays at high pressure expansion occurred on drying. Ball clays and china clays differed at low but not at high pressures. At high pressures many of the usual differences between clays, e.g., drying shrinkage, tendency to crack etc., disappeared.

840. Westmann, A. E. R. Am. Cer. Soc., J. v 17 n 5 May 1934
p. 128-34
EFFECT OF MECHANICAL PRESSURE ON DRYING AND FIRING PROPERTIES OF TYPICAL CERAMIC BODIES.

841. Williamson, W. O. Trans. Brit. Ceram. Soc., 46, 77, 1947
SOME OBSERVATIONS ON THE BEHAVIOUR OF WATER IN CERAMIC MATERIALS. Current opinions on the nature of the clay-water relationship are critically reviewed, and difficulties in accepting the idea that the adsorbed water has the structure of ordinary ice are outlined. The association between water and non-plastics is discussed; implications in the literature that such materials are not solvated cannot be sustained. Attention is directed to the work of von Buzágh on inter-particle forces. If his findings can be validly extended to plastic clay they suggest that long-range attractive forces exist in this system and accompany a resistance to approach arising from the lyospheres round the particles. For a typical earthenware body in the plastic state a relationship is established between moisture content and dry porosity; this is explicable in terms of a varying degree of particle orientation. Differences in moisture content produced by compression or centrifuging of unconfined specimens are related to Reynolds' dilatancy. This dilatancy is manifested by the non-plastic content of the body, but is not obvious in the ball and china clays. Short-term ageing of certain test-pieces in saturated air does not yield a more even distribution of water even

where aqueous migration occurs. The relationship mentioned above suggests that a completely homogeneous moisture content may be unobtainable. The backlash phenomenon of Macey is more widely prevalent than is commonly supposed; it is reported in ball clay, china clay, flint, Cornish stone, felspar, earthenware, bone china and brick clays. In earthenware, the portion of the test-piece undergoing alternating tension and compression becomes more hydrous from the operation of Reynolds' dilatancy; this increased moisture content does not appear consistently in ball and china clays. The cause of backlash is discussed, and a brief comment is made on the warping and cracking of clayware in the light of the foregoing work

842. Williamson, W. O. Amer.J.Sci.,245,645,1947
THE FABRIC, WATER-DISTRIBUTION, DRYING-SHRINKAGE, AND POROSITY OF SOME SHAPED DISCS OF CLAY. The petrofabrics of shaped disks of a typical plastic clay are described and correlated with water-distribution, differential drying-shrinkage, and porosity. The re-arrangement of the clay during plastic deformation involves the production of new structures which include orientated aggregates; a connection between such re-arrangement and shear-hardening is probable. (5 figs., 5 tables.)

843. Williamson, W. O. Research, 1,No.8,363-7,May 1948
C.S.I.R. Australia
THE CLAY/WATER RELATIONSHIP. The intimate nature of the clay/water relationship is discussed, on the evidence advanced by various workers. The degree of constraint of the water at the particle surface, the lattice structures possible and relations wit metallic ions. The investigation of clay/organic compound relations would probably throw light on the water relations. 22 references.

844. Zankowitch, F. A. Steklo.i.Keram,7,46-50,1931
CIRCULATION OF WATER IN CLAY MASSES DURING DRYING. Comparison of shrinkage and moisture gradients.

Equipment

345. Anon. Tonindustrie Zeitung(Berlin),54,No.53, July 3,1930,pp.879-880,3 figs.
BRICK DRIERS:- Zigzag Drying Installation (Die Zick-Zack-Trocknerei). In this installation movement of air in drying chambers is similar to that of fire in zigzag kiln; ventilator supplies fresh air and regulates temperature and humidity of drying air.

346. Anon. Tonindustrie-Ztg v 59 n 69 Aug.26 1935 P 832-3: see also discussion in n 88 Oct.31 p.1093
EINE NEUE ZIEGELTROCKENANLAGE. Illustrated description of new brick drying plant working on uniflow and intermittent-flow principle and consisting of two chambers which can have width of 1.5 m, if desired; drier operates only with pure hot air; name of builder not given.

347. Anon. Clay Craft 14,231 1941
A UNIQUE TUNNEL DRYER. A tunnel dryer is described, 88 ft. long, 32 ft. wide (12 cars length and 6 cars wide); for 30,000 bricks per day. The unique feature is the use of 17 small fans of 1 H.P. each on the top flue installed on the roof of the dryer along one side, for cross circulation between the pallets caused by the fans and one large high pressure recirculating fan which supplies air to at least 3 car lengths.

348. Anon. Brick Clay Rec.99,(2)15 1941
Reinforced Tile Beam saves £1,000 in Dryer Construction. This was a roof of reinforced clay tile slabs on a new 8 tunnel dryer.

349. Anon. Brick Clay Rec.99,(4)19,1941
DRY AND BURN 70,000 BRICKS IN 40 HOURS WITH INDUSTRY'S STRANGEST TUNNEL KILN. A new tunnel kiln at the plant of the Streater Brick Co. is controlled by 2 men and has a low fuel consumption.

350. Anon. Tonind.Ztg., 67,166,1943
OPEN-AIR DRYERS AND THEIR MECHANISATION. For seasonal brickworks, with outputs of up to 3 million bricks, conversion to all-the-year-round operation is not considered economical. The best opportunity for rationalisation lies in the reduction of the manpower required, especially that needed for transport between plant and dryers and between dryers and kiln. Such brickworks generally use so-called open-air dryers. Three possibilities arise: (a) layout of drying sheds and open-air dryers to secure shortest distances of transport; (b) design of sheds to obtain shortest drying time; (c) mechanisation

of the transport. Four systems of mechanical transport are considered, viz. circular transporter, Keller cars, Hartmann cars, electric or petrol-driven railless cars. The circular transporte does away with ordinary dryer cars and conveys both green and dry brick. Drying sheds at different levels may be served, and, by extending the system and using roller conveyors, setting and drawin of the kiln may be mechanised. The chief disadvantage compared to other mechanical systems is the labour required in the dryers.

851. Anon. Claycraft, 1947, 20, 466
EXTENSIONS AT KEYMER BRICK AND TILE CO. The Burgess Hill Works were selected for modernisation and expansion in a general scheme c reorganization. The works are divided into three units, each bein highly mechanised.

852. Anon. Brick Clay Rec., 114, No. 1, 53, 1949
A 4-CHAMBER BATCH DRIER. Comments are invited on a proposed 4-tunnel or 4-chamber batch dryer, each tunnel or chamber to be 7 ft. wide and to have a capacity of 20,000 bricks. Other manufacturing details are given. The opinion is expressed that such a dryer is feasible. (1 fig.)

853. Aebi, R. and Cie., A. G. Brit. Pat. 601,265, 3/5/48
DRYING PLANT FOR TILES AND BRICKS. A dryer for tiles and bricks has a conveyor line moving horizontally along a zig-zag course through a drying chamber. The drying air flows horizontally through the drying chamber and across the different branches of the conveyor line. (3 figs.)

854. Gallaus, C. Tonindustrie-Ztg v 56 n 94 Nov. 21, 1932 p. 1162
DIE WARMLUFT-GEBLAESETROCKNEREI. Hot-air blower drying plants; schematic drawing showing layout of plant with blower for driers located on side of ring kiln; advantages of this type of drying plant.

855. Grosskinsky, E. Ziegelwelt, 62, No. 11, May 28, 1931, pp. 152-153
UNIVERSAL KILN AND ITS OPERATION. See also brief translated abstracts in Ceramic Soc. Trans., 30, No. 7, July 1931, pp. 54-55.

856. Isenhour, C. W. Brick Clay Rec., 1946, 108, No. 3, 60-63
STRAIGHT LINE DRYER-KILN MAKES 45 TO 50 TONS OF BRICK AND TILE IN 24 HOURS. The design and performance of a combined dryer and an oil-fired tunnel kiln are described. The ware is set directly on kiln cars from the off-bearing belt. The dryer is 106 ft. long and holds 15 cars; the kiln is 152 ft. long and holds 22 cars. Each is a separate unit. The cars are moved by a hydraulic pusher. A special feature is the extra large capacity fans on the kiln and dryer.

857. Lurie, M. Tonindustrie-Ztg v 60 n 28 and 29
Michailoff, N. Apr. 6 1936 p 365-7 and Apr. 9 p 376-7

DIE BEDEUTUNG DER KUENSTLICHEN ZIEGELTROCKNUNG. Artificial brick drying; investigation at Moscow Institute of Fuel Technology, on four highly plastic clays, based on which new drying system was developed; unit consists of separate chambers having single furnace and single ventilator, with aid of which mixture of flue gases and air or waste gases from Hoffman kiln are passed into two distribution canals laid in floor along both sides of chambers.

858. Pinkl, V. Tonindustrie-Zeitung, 55, No. 40, May 18, 1931, pp. 589-590, 2 figs.

FAULTY CONSTRUCTION OF AIR DRYING PLANTS. Basic requirements of well-designed drying plant; faults in planning of drying installation and how to avoid them.

859. Robson, J. T. Bull. Amer. Ceram. Soc., 15 Mar. 1946, 25, 94-9

MODERN BRICK-PLANT LAYOUTS. The use of drier cars versus kiln cars as drying conveyors in modern brick manufacture is compared. Modern plant layouts using both methods of operation are described and illustrated.

860. Scholz, F. Tonindustrie-Ztg v 60 n 82 Oct. 12 1936 p. 1014-6

TROCKNEREI-LEICHTBAUTEN IN ZIEGELEIEN. Light weight construction in brick drying plants; examples of wood and light steel construction; advantages of latter pointed out.

861. Schramm, R. Tonind. Ztg., 66, 352, 1942

THE TUNNEL DRYER. The paper on tunnel dryers by Schnell is completed. The dryer is divided into three equal zones, the first zone is equipped with a small number of ribbed pipes. The second is a warm, and the third a hot zone. A mixing chamber runs through the dryer bottom, diagonally to the length of the covered tunnel. The mixing chamber has a fan which circulates the air into the drying chamber. A fan draws off the saturated air from the stagnant zone. With eight tunnels 24,000 Dutch tiles are dried in 24 hours and with two tunnels 6,000-8,000 hollow bricks. Shift work is essential in the dryer and good results can only be attained when the total heat in all three zones and the air moisture in the first zone can be kept constant.

862. Schulz, G. Tonindustrie-Zeitung, 55, No. 80, Oct. 5, 1931, pp. 1126

OPEN-AIR DRYING PLANTS. Automatic settling device with scaffold frame used in connection with open-air drying, with special reference to Hartmann system.

863. Schulz, K. O. Tonind. Ztg. 56, 547-8 (1932) May 26
Induced draft vs. low pressure in brick drying. New type of drying plant and drying process are described.

864. Watts, A. J. C. Tr. Br. Ceram Soc. 49 (2) 43-57 Feb. 1950
III. SOME NOTES ON BRICK AND TILE DRYERS. Paper deals with 4 different types of dryers, 2 brick and 2 tile dryers. Three us heat from kilns and one of the tile dryers is the specially constructed zone dryer using hot air from kilns. The zones are coupled by suitable ducting for any combination, the zones being set as a square. Fullest use of waste heat is attained thereby. 9 illustrations and running costs given. The low wastage figures are noteworthy.

865. Weck, C. H. Tonind. Ztg. 65 390 1941
THE AUTOMATIC STOKER IN THE BRICK AND MINERAL INDUSTRY.

866. Whittemore, J. W. Bull. Amr. Ceram. Soc. 18 367 1939
USE AND ECONOMY OF A ROTARY DRYER IN THE MANUFACTURE OF BRICKS AND TILES. A Rotary dryer 42 inch diameter and 36 ft. long is used for drying tailings from screens. The tailings are fed by a belt conveyor and passed to the grinding pan. The capacity of the grinding equipment is thereby increased.

General Process

867. Anon. Tonindustrie-Zeitung, 54, No. 80, Oct. 6, 1930, pp. 1276-1278
POSSIBILITIES OF BRICK DRYING. See also brief translated abstract in American Ceramic Society - Jl., 14, No. 1, January 1931, pages 34-35. Different ways of drying brick; plain drying, oldest and most unreliable, consists in drying brick in ai and sun; drying in sheds is also uncertain method; artificial drying, wherein drying installations are built above kiln and bric are dried by heat from kiln; drying installations most used are described.

868. Anon. Tonindustrie-Zeitung, 55, No. 61, July 30, 1931, pp. 889-890, 1 fig.
BRICK DRYING IN AIR DRYING SHEDS. With reference to article previously indexed from May 18, 1931, issue of same journal under heading of Brick Driers-Design, present writer points out that imperfect design of drying plant is often not fault of owner, and offers constructive suggestions for successful operation of existing plants, both technically and economically.

869. Anon. Zement Ztg. 58, 167-8, Feb. 15, 1934
THE DRYING OF SILICA BRICKS.

870. Anon. Tonind. Ztg. 65, 567, 1941
HEATING AND OPERATIONAL PROBLEMS IN ARTIFICIAL DRYING. Drying plant is above the kilns. Vapour must be removed quickly to avoid deterioration of the roof. 28 chambers, 280,000 bricks capacity.

871. Anon. Br. Clayworker 53, 94, 1944
HOT AIR. A discussion of Kiln operation and design with a view to the most efficient use of heat.

872. ---- Ministry of Works, London, 1947. H. M. S. O.
REPORT OF THE TECHNICAL COMMITTEE OF THE NATIONAL BRICK COUNCIL.

873. Avenhaus Tonindustrie-Ztg v 60 n 23 and 24 Mar. 19 1936 p. 295-6 and Mar. 23 p. 307-9
RAW MATERIALS AND BRICK DRYING. Theoretical discussion of dehydration and drying processes; drying of clay and brick; brick drying plants.

874. Barrett, W. Brick & Clay Rec v 90 n 5 May 1937 p 277-8
REDUCE DRYER WASTE BY PROPER CONTROL. For best results, reduce drying temperature during day and do most of drying at night; proper setting of lugged pavers explained.

875. Baumeister, F. Tonindustrie-Ztg v 60 n 48 June 15 1936 p 593-6
DRYING COSTS FOR 1,000 BRICK. Investigation to determine comparative costs of artificial and open-air drying.

876. Bodin, V. Rev. Mat. Constr., (B) 1946, No. 369, 104)
DELICATE PHASE IN MANUFACTURE OF BRICKS AND TILES. Continuous dryers reduce drying times from between 15 to 30 days for small hacks set round the outside of a continuous kiln or multi-storey drying frames for tiles, to between 2 and 4 days. Chamber dryers offer the advantage of mechanised handling, and do not require so many cars; tunnel dryers are considered scarcely to have reached a final form, although they can also be included in a mechanised cycle. A sketch illustrates the flow of air longitudinally and in the cross-section of a tunnel dryer.

877. Brown, A. E. Clayworker Press London, 1936, 240 pp.
PRACTICAL CLAY WORKING. Describes manufacture of bricks and tiles. Chapter 9. Methods of Drying of Clay goods.

878. Buch, A. Archiv fuer Waermewirtschaft (Berlin), 11, No. 10, Oct. 1930, p. 347
DRYING OF BRICK WITH WASTE HEAT. Discussion abstracted from paper previously indexed from Berichte der Deutschen Keramischen Gesellschaft, February 1930, classified under Brickmaking Plants-Economics; balance of ring kiln; heat requirement for drying.

879. Chambers, J. H. and Engineering 134, 472(1932)
Weyt, W.
DRYING OF MAGNESITE BRICK. VOLUME CHANGES ACCOMPANYING HYDRATION.

880. Chesters, J. H. and Trans.Br.Ceramic.Soc.42 199, 1943
Howie, T. W.
THE DRYING OF MAGNESITE BRICKS, II. For Part I see Trans., 32, 201, 1933.

881. Clauss, R. Tonind.Ztg.65 170 1941
CHAMBER OR TUNNEL DRYER. The merits, etc. of each are given. Chamber dryers are more difficult to control on account of valves, etc., and the close observation necessary, doors, flues, conveyors, etc., and there are high maintenance costs. Costs and equivalent designs are given.

882. Clauss, R. Tonind.Ztg.65 525 1941
THE NATURE OF BRICK DRYING. Time of drying is controlled by water content and plasticity, a fat clay taking longer to dry. Natural drying is incomplete and unreliable.

883. Clauss, R. Tonind Ztg.65 559, 1941
A DRYING BALANCE DEVICE. A simple arrangement for determining los in weight of a single brick enables progress of drying to be followed.

884. Clauss, R. Tonind Ztg 65 584, 1941
HEAT SOURCES FOR DRYING BRICKS. The use of waste steam is limited Flue gases cause deterioration of kiln. The greater the output of bricks, the higher the proportion that can be dried by waste heat.

885. Clauss, R. Tonind. Ztg., 66, 382, 1942
THE COMPARATIVE SURVEY OF THE ECONOMY OF SOME BRICK-DRYING PLANTS. The development and modification of ideas as to the performance to be expected from brickworks dryers is briefly described. Emphasis is laid on the difficulty of determining accurately the coal consumption for live steam when this is supplied to the dryer in addition to exhaust steam. In dryers using waste gases from the kiln it is not generally easy to estimate the quantity of heat supplied in this form.

886. Czerny, R. Ziegelwelt, 62, No. 4, Feb. 19, 1931, pp. 45-47
THERMOTECHNICAL PROBLEM IN ARTIFICIAL DRYING OF BRICK. Reciprocal relations between air volumes, inlet temperatures, calorific values and water absorptivity. (To be continued)

887. Czerny, R. Ziegelwelt, 62, No. 9, Apr. 30, 1931, pp. 122-123

THERMOTECHNICAL PROBLEM IN ARTIFICIAL DRYING OF BRICK. Calculations are presented which, it is claimed can be applied to any drying system under given conditions, and which give good insight into reciprocal influence of important factors. (Concluded).

888. Czerny, R. Tonindustrie-Ztg. 59, No. 104 Dec. 30 1935 p. 1271-2

POWER REQUIREMENT OF ARTIFICIAL CHAMBER DRIERS FOR BRICK; means of reducing power consumption shown.

889. Damaskin, S. A. Prom. Stroitel. Materialov, 2(12)33, 1940

NEW TYPE OF DRYER FOR THE CERAMIC INDUSTRY. Proposed by Professor Odelsky. Water vapour from the goods condenses on glass walls with overlapping panes. Water runs down the outside where the air temperature is 5-7°C. Fuel consumption 2.2 cwt. per 1,000 standard bricks. Dryer was economical to construct and operate, and tender clays could be successfully dried.

890. Geiger, F. Ton-ind. Ztg. 66, 113, 1942

THE COOLING AND SPECIFIC HEAT OF DRY AND MOIST NATURAL AND ARTIFICIAL BUILDING MATERIALS. The great influence of moisture on the thermal properties at -25° to + 50°C. is demonstrated.

891. Glauber Tonind. Ztg., 67, 77, 1943

ARTIFICIAL DRYING AND RATIONALISATION. A criticism of the use of artificial dryers, especially for yearly outputs of less than 5 million bricks, is contested under each of its five headings, viz. use of artificial drying and mechanisation for too small an output; high installation costs due to excess capacity; high drying costs; lack of consideration of the peculiarities of the raw material; and effects attributable to mistaken choice between chamber and tunnel dryers. The suggestion that there is a modern danger of depending too much on "theoretical mathematics and physics" and too little on experience, is also dealt with.

892. Gottlieb, M. B. Ogneuporu 8, 383, 1940

OPERATION OF A NEW TUNNEL DRYER AT THE SEMILUK WORKS. Uses waste gases and excess air from a kiln and dries 200 tons of bricks a day.

893. Grady, R. F. Brick Clay Rec., 102, No. 6, 41, 1943

AUTOMATIC CONTROLS ON PERIODIC DRYER SPEED PRODUCTION OF HAND-MADE REFRACTORY SHAPES. The capacity of the Malvern Brick and Tile Co. (Arkansas, U.S.A.) was doubled in 1941 without increasing the number of kilns or dryers. This was achieved by installing control equipment. In the case of the dryers, controlled humidity enables 230 cars of 12 x 12 x 18 in. hollow blocks to be dried in 8 hours in a dryer having a capacity of 176 cars. The control system permits any desired humidity schedule to be maintained for a drying cycle up to 6 days in length; it is operated by cams cut to a pre-calculated shape. The use of a single-pole, triple-throw, mercury switch permits the control of both the "over" and "under" wet and dry bulb temperatures. The wet and dry bulb temperatures are controlled individually. The dry bulb controller operates a damper and a gas valve; the wet bulb controller operates a water pump and a second damper. Other features of the plant are briefly mentioned.

894. Knapp, E. W. Brick and Clay Rec. 84 and 85
Nos. 7, 8 and 9, July 1934 p. 242-4, Aug.
p. 57-60 and 64, Sept. p. 92-3 and 102

IMPROVING DRYING PRACTICE. Difficulties met with in dryer operations; satisfactory results obtained by remodelling the dryer.

895. Knapp, E. W. Brick and Clay Rec. 86 No. 5 May 1935,
p. 169

BRICK DRIERS. COMMERCIAL DRYER THAT CONTROLS DRYING AS EFFICIENTLY AS LABORATORY MODEL. Automatic pallet-type drier claimed to be adjustable to any drying condition.

896. Koller, R. Tonindustrie-Ztg. 58 No. 6 Jan. 18 1934
p. 66

TROCKENFEHLER BEI HOHLZIEGELN. Defects in drying hollow wall tiles; brief supplement to discussions by E. Schondorff and G. B. Singer, previously indexed from November 9 and December 11, 1933 issues of same journal.

897. Kritchenka and Belikar Ogneuporu 13, 36, 1948

ORGANISATION OF THE DRYING DEPARTMENT OF THE RED STAR FACTORY. Organisation of monthly output of bricks to avoid bottlenecks.

898. Krug, H. Arbeits Gem. Thur. Verleger, 1949, 300 pp.

ARBEITSKUNDE IN DER ZIEGAL INDUSTRIE.

899. Leder, W. Ziegelwelt 63 No. 14 and 17 July 14 193
p. 138-40, and Aug. 25, p. 167-8

ZIEGELTROCKNUNG MITTELS ABWAERME. Brick drying by means of waste heat; investigation of number of brick which can be dried by means of cooling heat of 10,000 bricks and by means of heat of exhaust steam of 60-hp steam engine.

900. Lipinski, F. Tonindustrie-Zeitung, 55, No. 19, Mar. 5,
1931, pp. 272-274, 2 figs.

DRYING WITH MOIST AIR. Method of brick drying with moist air was developed for purpose of covering shortcomings of artificial drying it is based on fact that diffusion capacity of clays increases onsiderably with increase in temperature of clay; advantages of rocess with which, it is claimed bodies with most difficult rying properties, can be thoroughly dried in very short time.

01. Lipinski, F. Tonindustrie-Zeitung, 55, Nos. 64, 65 and 66, Aug. 10, 1931, pp. 921-922, Aug. 13, pp. 934-935, and Aug. 17, pp. 945-946, 10 figs.
BRICK DRYING. Advantages of moist-air drying and examples of plants employing this system of drying; comparison with other drying systems.

02. Macke, J. Tonind.Ztg., 67, 150, 1943
ARTIFICIAL DRYING AND RATIONALISATION. Commenting on two earlier articles on this subject, the author contradicts statements that artificial dryers are uneconomical with an annual output of less than 5 million bricks. He uses a dryer of this type on a works with a yearly output of only 1.2 million. It was installed to increase production and reduce labour, and has converted the works from seasonal to all-the-year-round working. The dryer is heated by waste steam in daytime and live steam from a special boiler at night.

03. Macey, H. H., Wilde, F. G. Trans.Br.Ceram.Soc. 43, 93, 1944
THE DRYING OF CLAY. Hot floor drying. The factors affecting the rate of drying of bricks and rectangular blocks on the hot floor.

04. Macey, H. H., Wilde, F. G. Trans.Br.Ceram.Soc. 43, 100, 1944
THE DRYING OF CLAY. A comparison of methods of drying as applied to some common bricks.

05. Madgwick, E. Phil.Mag. (7) 13, 632 (1932)
PENETRATION OF WATER INTO POROUS BUILDING MATERIALS. Fairly simple treatment of capillary forces and integration to relation between distance and time.

05a. Miller, A. Min.Wks.Nat.Brick Adv.Council. Paper 6, 79 pp. H.M.S.O. 1950
CLAY BRICKMAKING IN GREAT BRITAIN. A SURVEY OF THE METHODS USED.

06. Pinkl, V. Ziegelwelt 65, No. 14 July 12 1934, p. 141-4
DISCUSSION OF WHAT SYSTEM OF BRICK DRYING OFFERS GREATEST ADVANTAGES; four examples given.

07. Rikart, I. E. Steklo-i-Keram 5, (8) 14-16 1948 Chem. Abstr. 43, 1931, Mar. 1949
IMPROVED DRYING OF GREEN BRICK WITH SULPHUR DIOXIDE. Sulphur-rich fuel (4-8%S) or low Sulphur fuel such as coke to which SO_2 producing

admixture has been added to give 0.5 gm. SO_2 per cubic metre of combustion gas is utilised. Steam is added if the moisture conten is less than 25-35 gm/c.m. of gas. Drying temperatures can be raised, and drying time can be reduced. The process is more economical than the use of electrolytes.

908. Sachse, H. E. Tonind. Ztg. 67, 193, 1943
ARTIFICIAL DRYING OF BRICKS. Is the heat from cooling chambers in the continuous kiln together with exhaust from the steam engine sufficient to dry the bricks in a chamber dryer? Detailed calculations of the heat required are given, using formulae to check results obtained by employing the heat-content: moisture-content diagram. The latter is explained. The heat available is then calculated, making certain assumptions as to the heat content of the kiln walls and floor, and is found to be 85% of the total required. The velocity of the air through the cooling chambers is estimated at 7.2ft./sec.

909. Searle, A. B. Brit. Claywkr., 57, 284, 1949
THE MODERN APPROACH TO DRYING PROBLEMS. The advantage of manufacturing bricks and tiles by the pressing and the wire-cut process is discussed in relation to drying. For plastic goods, which need intermediate drying, the three main sources of heat are burning fue steam, and waste heat. Infra-red heating is good for rapid drying and in conjunction with other means may be effective and economical Heat required is not needed for the goods only, and reasons for thi are given. Means should be sought to reduce or recover waste heat by recirculation; loss of heat by leakage of air and hot gases can also be serious. Corridor dryers are most effective when used in conjunction with intermittent or ordinary continuous kilns; the chief advantage is in the use of special cars carrying goods direct from the machines to the dryer, and thence to the kiln. 6 Figs.

910. Schondorff, E. Tonindustrie-Ztg. 58, 96-101 (1934) Jan. 29
INVESTIGATIONS OF ARTIFICIAL DRYING INSTALLATION FOR BRICK. Consisting of 27 dryers each 17m. long; flowsheet of plant; results of tests given in diagrams; cause of defective drying.

911. Schiele, L. Tonindustrie-Ztg. 60, No. 46 June 8 1936
p. 567-8
BRICK MANUFACTURE IN TROPICS; Influence of climatic conditions, et on processes employed, such as drying and firing; brief descriptio of wood-burning zigzag kiln with capacity of 50,000 brick.

912. Schulz, G. Tonindustrie-Ztg. 58, No. 5 Jan. 15 1934
p. 50-1
PROTECTION OF OPEN-AIR BRICK DRYING PLANTS FROM NIGHT FROST; Brief note on experience at brickmaking plant in Mecklenburg, Germany.

913. Schulz, K. O. Tonindustrie-Ztg. 59, No. 73 Sept. 9 1935
p. 900-2

RELATION OF VAPOR PRESSURE TO DRYING IN BRICK DRYING PLANTS: examples given to show that differences in vapor pressure in material to be dried and in air have important influence on drying process.

914. Spingler, K. Tonind. Ztg., 67, 55, 1943

PRACTICAL FIGURES AND CALCULATION DATA FOR DRYING. The author first reviews the physical principles involved in removing, with the aid of warm air, the water used in making the body from the green brick; the economic and technical aspects of drying are then briefly discussed.

915. Stull, R. T., Johnson, P. V. Bull. Amer. Ceram. Soc. 20, 443, 1941

RELATIONS BETWEEN AIR AND WATER PERMEABILITIES OF BUILDING BRICK. Permeabilities determined on 5 series of bricks. Under continuous flow, the air permeability was not inversely proportional to the viscosities of the two fluids, in conformity with Poiseulle's equation, although the ratio approached this proportion as the mean effective capillary size of the brick increased.

916. Thor, P., Spingler, K. Tonind. Zig., 67, 154, 1943

PRACTICAL FIGURES AND CALCULATIONS IN DRYING. This is a continuation of a discussion. P. Thor:- Referring to an article by K. Spingler (ibid., 67, 55, 1943) the present author questions a figure of 60-100 kg. of warm, air said to be requisite for drying out 1 kg. of water. He gives figures for a chamber dryer showing an average of about 27 kg. of air per kg. of water. K. Spingler: Defending his statements S. calculates that to achieve so much drying the air would have to enter the kiln at a temperature between 175° and 230°C. even with recirculation. The incompleteness of Thor's data is criticised.

917. Thor, P. Tonindustrie-Zeitung (Berlin), 54,
Nos. 73 and 74, and Sept. 11, 1930,
pp. 1193-1194, and Sept. 15, pp. 1202-1203

AVAILABLE HEAT SOURCES FOR ARTIFICIAL BRICK DRYING. Evaluation of heating sources in low-pressure drying plant with efficiency of 72 per cent; calculation of heat to be derived from exhaust steam, furnace waste heat and ring-kiln flue gases, and volume of moisture to be dried out with these waste gases.

918. Thor, P. Tonindustrie-Zeitung, 55, Nos. 96 and 97,
Nov. 30, 1930, pp. 1323-1325 and Dec. 3,
pp. 1341-1342, 6 figs.

STATUS OF BRICK DRYING. Economic aim must be to dry with minimum amount of air at highest possible temperatures; moist air drying; tunnel driers.

919. Thor, P. Tonindustrie-Ztg 59, No. 85 and 97
Oct. 21 1935 p. 1054-5 and Dec. 2 p. 1204-5,
and 60, No. 10 Feb. 3 1936 p. 125-7.
October 21: Free sources of heat for artificial drying plants in brickmaking plants discussed, December 2: Discussion by F. Schuenhoff and reply by Thor. February 3 1936: Further discussions by Schuenhoff, A. Rischer and F. Baumeister.

920. Watkins, C. M. Trans. Ceram. Soc. 33, 444-477 Oct. 1934
Butterworth, B.
THE ABSORPTION OF WATER BY CLAY BUILDING BRICKS, AND SOME RELATED PROPERTIES.

921. Whittaker, L. R. Brick 96, (3) 18, (4), 19, 1940
DRYING TROUBLES, IV. The problem of condensation at the cold end i discussed and the optimum conditions of air circulation are given. The various points in construction of dryers for promoting high efficiency are discussed.

922. Whittaker, L. R. Brick 96, (5) 23, 1940
DRYING TROUBLES, VI. The maintenance of temperature is discussed. Dryer studies have shewn that there is sufficient heat in a cooling kiln to dry the bricks required to reset it. Usually there is excess.

923. Yaroshevsky, A. V. Prom. Stroit. Mat., 2, No. 12, 36, 1940
FORMULA FOR CALCULATING THE LENGTH OF A COUNTER-FLOW TUNNEL DRYER. Formulae are presented relating the quantity of water evaporated from the green bricks to the length of the tunnel for different drying conditions; these formulae are based on exceptional data. If the coefficients of the formulae are accurately determined for different initial moisture contents, setting densities, and rates of travel of the drying cars, it is claimed that a complete solution of tunnel dryer problems is possible.

924. Zaiman, A., MacIntyre, W. A. Building Research Stn. D. S. I. R. Special
Reports 16-33, 1933
ECONOMY AND MANUFACTURING ASPECTS OF THE BUILDING BRICK INDUSTRY.

925. Allday, R. S. Brick Clay Rec., 113, No. 1, 48, 1948
"INFRA-RED" DRYING UPS PRODUCTION 25%; CUTS BATTING AND CHECK LOSS T ZERO. A large-scale infra-red dryer is used for buff facing bricks After one month's use production increased 25%, quality was improved losses from cracking practically ceased, and an even production was possible throughout the winter. Care is necessary in the arrangement of the burners, which will operate on either gas or oil. The unit consists of 42 burners and consumes 720 cu. ft. gas/hr. Similar drying is successfully used in some American china factories where it is possible to dry a jiggered plate and mould in a 15-18 mi cycle. (1 fig.)

926. Kreidl, E. L. Brick Clay Rec., 113, No. 3, 62, 1948
LOW COST SYSTEM AT ALIDAY PLANT SHOWS HOW DRYING CAN BE IMPROVED. Drying bricks by radiant heat is effective only when there is no heat reflection from the ware and surface heat is absorbed, and when heat losses from the ware to the surrounding air are minimized. Infra-red radiation will penetrate a thin surface layer only and transfer of heat to the interior will be due to conduction and convection. The combination of a radiant heat source and a somewhat stagnant furnace allows even drying without local over-heating and too rapid dehumidification of the surface. Over-heating, or too rapid drying, reduces the heat transfer and the diffusion of the water; it also sets up increased drying strains.

iles

927. Anon. Brick Clay Rec., 99, No. 6, 36, 1941
DRAIN-TILE DRYING RACK SAVES FLOOR SPACE. A rack is described on which 168 pipes can be dried in a space of 50 sq. ft. The pipes should dry for 1-2 days in a vertical position before being placed horizontally on the racks for final drying.

928. Anon. Brit. Clayworker 1943, 52, 22-23
TILE AND FIELD DRAIN DRYING PLANT. The drying plant consists of a superheated hot water system, the boiler being designed to utilise waste heat from the kilns both during firing and cooling.

929. Macey, H. H. Br. Cer. Res. Ass. Paper No. 27 Trans. Br. Cer. Soc. 50, 3, 87-100, March '51
SOME EXPTS. ON THE SPLITTING OF EXTRUDED FLOOR TILES. Variation of M. content through the cross section of the extruded column was established, and the effect of this variation on drying was investigated. The results of expts. emphasise the value of shielding the cut edges of the bats during drying.

931. McIntyre, W. A., Zaiman, A. Building Research Station D. S. I. R. Bull. No. 4, 1928, 22 pp.
THE MANUFACTURE OF ROOFING TILES IN FRANCE, BELGIUM AND HOLLAND.

FOUNDRY CORES AND MOULDS

Equipment and Process

932. Anon. Foundry Trade Jl., 44, No. 772, June 4, 1931, pp. 385-386, 5 figs.

A NOVEL DRYING STOVE. Vertical continuous drying stove designed by W. H. Smith, director of Foundry & Engineering Co. West Bromwich.

933. Anon. Zeit. fuer die Gesamte Giessereipraxis, 52, No. 18, May 3, 1931, pp. 143-144, 3 figs.

AUTOMATIC DRAFT REGULATORS FOR FOUNDRY DRIERS. Regulators described were originally intended for ceramic industry but are equally well adapted for foundry driers; principles upon which they work, and economies effected by their use.

934. Anon. Giessereipraxis 57, Nos. 35-36 Aug. 30 1936 p. 368-70.

NEW MOVABLE OVEN FOR DRYING OF FOUNDRY MOLDS OF LARGE DIMENSIONS; illustrated description of design and operation.

935. ---- Iron Age, 162, p. 95-8, 8.7.1948

CORE BAKING TUNNEL.

936. ---- Industr. Heating 15.4.1948 15, p. 647, p. 829

LARGE CONVEYERISED CORE OVENS (at Ford Motor Works)

937. ---- Grey Iron Founding. Productivity Team Report Sept. 1950 pp. 63-64, 99, 114

A brief description of drying practice in U.S.A. with diagrams. Drying temperatures were 400°F to 450°F.

938. Arend, A. G. Br. Steel Maker 9, p. 350 9 Aug. 1943

RECENT DEVELOPMENTS IN CORE DRYING.

939. Aronovitch, V. Foundry Trade J 52 No. 982 June 13 1935 p. 393-6

CONTROL OF MOULD DRYING PROCESSES. Simple, dependable direct-dryin control method, developed by author in Soviet-Union; principle consists in measuring electric conductivity of moist molds and cores during actual drying period.

940. Barnett, C. A. Amer. Foundry Assn. Preprint. No. 1949-36

MODERN FOUNDRY CORE AND MOLD OVENS.

941. Comessa-Shilde Revue de Fonderic Moderne 24 215 6/1930

PROCESS OF CORE DRYING.

942. Cracknell, A., Cousans, F. Foundry Tr.Jnl.82.313.1947.
SOME NOTES ON THE SURFACE DRYING OF MOULDS. Hot air from a furnace was directed through a pipe on to the surface of the mold. All variables were recorded and the rate of drying measured, but little information was obtained concerning moisture gradients or of the rate of drying of the deep layers. Significant information was obtained, however, by use of this method.

943/4. Dickinson, F. Gas Jnl.257(4471) p.307.9.2.1949.
COMMERCIAL UTILISATION OF GAS. CORE AND MOULD DRYING. Description of making and drying. Sizes of ovens and temperatures. Advances in gas heating are described. Heat losses from a gas heated stove 16'8" wide, 8'6" high and 24 feet deep with drilled bar rails which dried 25 tons at about 500^{0}F in 10 hours with 150 therms of gas.
Estimated heat balance:-

Heat losses, walls, floor, roof	10,000 c. ft.
" " iron door	5,000 " "
Heat for evap. of moisture	2,500 " "
" " air changes	2,500 " "
" " load	10,000 " "

A 3 inch insulation of the door might have saved 4,000 c. ft.

945. Fiegehen, E. G. Machy Market No. 1754 and 1755 June 15 1934 p.489-90 and June 22 p.511.
OVEN-DRYING OF CORES AND MOULDS. Water as aid to baking; types of binders used; how linseed oil acts; mold and core-drying compared; core ovens; loading considerations; core plates; temperature control; continuous core ovens; heat supply; electric ovens.

946. Forslund, S. H. C. Gjuteriët 1947 37(6) 111-17.(7) 123-131.
Review of types of oven and their theoretical and economic aspects.

947. Hampton, G. T., Taylor, W. H. Inst.of Fuel Drying Study Paper given 3 Jan.1951.Engineering.171 Feb.1951.
DRYING OF FOUNDRY MOULDS AND CORES. Describes in considerable detail the various methods of drying sand, cores and moulds. Tables of performance data and costs.

948. Henon, M. G. Bull.de l'Assoc.Technique de Fonderie Apr.Jun.1944.
FUEL ECONOMY IN FOUNDRY STOVES.

949. Koritnig, O. T. Giesserei v 19 n 51/52 Dec.23 1932 1932 p.521-2.
ECONOMIC STEAM PRESSURE IN FOUNDRY DRYING PLANTS; required pressure of steam is dependent upon vapor losses; example given showing economy of drying plant in relation to pressure and advantage of cycle without condensing pot.

950. Küepper, J. Die Giesserei 27 p.297.9.8.1940.B.I.558. Oct.1948.
DRYING OF CORES (In German). High Temp. with restricted air supply gives poor cores. Best results are obtained in practice with continuous driers, but batch driers, especially when gas fired, can be satisfactory even for cores of widely differing sizes.

951. Küpper, J. Neue Giesserei 2.3.78-84.1949.
CORE DRYING. An account of various processes for drying foundry core incl. H.F. and I.R. drying.

952. Lane, H. M. Iron Age 146 p.42 17 Oct.1940.
MODERN CORE OVENS.

953. Linsley, H. E. American Foundryman 9.p.27.March 1946.
CORE OVENS. Equipment and processes for cylinder head molds and core and magnesium castings. Construction and operation of baking and drying ovens. Handling installations.

954. Morton, J. B. Foundry Tr.Jnl.Dec.1948.
FOUNDRY DRYING SYSTEMS.

955. Neustadter, D. Br.Patent.577,255.10.5.1946.
IMPROVEMENTS RELATING TO STOVES FOR DRYING FOUNDRY MOULDS AND CORES.

956. Nyberg, B. Gjuteriët.36.110.July 1946.
OIL BONDED CORES BAKED IN GAS FIRED AND ELECTRICALLY HEATED OVENS (in Swedish).

957. Rainus, R. N. Sudostroyeniye n 8 Aug.1936 p.591-9.
CONTROLLING DRYING OF MOLDS AND CORES BY MEASURING THEIR ELECTRIC CONDUCTIVITY. Description of original method developed in Soviet Union foundries; results of extensive laboratory and shop studies. Bibliography. (In Russian.).

958. Reinartz, L. F. Steel, 90, 23-4 Feb. 22 (1932).
Improved ladle stoppers by drying in vertical oven. Layout and operation of equipment for drying and handling ladle stoppers in open hearth dept. of Am. Rolling Mills Co., Middletown, Ohio; heat provide by natural gas burners.

959. Rigaut, P., Ulmer, G. Fonderie 38. 1491. Feb.1949.
THE ADVANTAGES OF RECIRCULATION IN FOUNDRY DRYERS, ESPECIALLY WITH OI GAS OR ELECTRIC HEATING.

960. Rogers, F. C. Amer.Foundryman,Jan.1946,9,76-77.
SAND MOULD DRYING WITH PROPANE-GAS TORCHES. A description is given o a propane torch which was designed for drying the surface of moulds. The torch uses compressed air at 90-105 lb./sq.in. and propane at 15-20 lb./sq.in.

61. Rolle, E. Die Giesserei 32 (1-2) p.516. 1945.
REPORT ON SOME RESEARCHES ON CORES. Discusses effects of air, nitrogen and carbon dioxide on drying.

62. Rolle, E., Arland, A. Die Giesserei 32 5-10 1945.
REPORT ON SOME RESEARCHES ON CORES. Effect of air velocity on the compressive strength of cores containing various binders. Strength increased with increasing air velocity.

63. Roll and Riess Die Giesserei v.29.p.320.18 Sept.1942.
ON CHEMICAL PROCESSES DURING DRYING OF CORES. (In German).

64. Schmidt Giesserei v 23 n 14 July 3 1936 p.341-2.
DRIERS FOR FOUNDRIES. Brief review of older and more modern mold and core driers.

5. Sheehan, J. J. Proc.Inst.Brit.Foundrymen.v 32 43-58-65. 1938-9.
CORE SHOP CONTROL.

6. Smith, W. H. Foundry Tr.Jnl.59.423 8/12/1938.
103 26/1/1939.
FOUNDRY DRYING AND CORE SHOP LAYOUT.

7. Troy, E. C. Foundry.76 p.92. June 1948.
FACTORS INFLUENCING CORE BAKING.

8. Willsea, J. Trans.Amer.Foundrymens' Assn.46 739-750-57.
WHAT HAPPENS TO A CORE IN A CORE OVEN. Presents specific statements on importance of water, and dry air in drying cores in an oven. Discussion.

gh Frequency Heating

9. ---- Automobile Eng.36 p.438.Oct.1946.
CORE BAKING: U.S. DEVELOPMENTS IN THE USE OF DIELECTRIC HEATING.

0. Calhoun et al Metal Industry,69.267-8.1946.
RADIO FREQUENCY DRYING. Cores dried in 5-10% of time required for ovendrying and possessed greater core strength. Costs comparable with older methods.

1. Calhoun, J.R., Clark, L.E., Salzberg, H.K. Foundry Tra.J.,80,405,1946.
DRYING OF FOUNDRY SAND CORES BY DIELECTRIC HEAT. The principal difference between dielectric and induction heating by high frequency is that the former refers to materials which are non-metallic and non-conductors; silica has an electrical resistivity value of 5 x 10^{17} ohms/c.c. The sand core is placed between two plates which act in

similar manner as a radio condenser. High-frequency alternating current fed into the electrodes imposes alternating strains on the silica molecules, forcing them into elastic vibration resulting in molecular friction and heat, and the higher the frequency the great the heat. Good results were obtained with cores weighing from ¼ t 40 lb. with a unit operating at a frequency of 4.5 M.cycles, in a capacity range of 0-30 micro-micro-farads. The sand mix for exper mental cores was:

	Parts by Weig
Ottawa silica sand (dry-AFA 65)	1,000
Sulphur	5
Boric acid	5
Cereal binder	5
Bentonite	3.3
"Thor" plastic binder	10
Water	40
Kerosene	5

The comparison of drying times for solid test cores with 4% moistur by oven and dielectrical methods are given below:

			Dielectric Heating	Core Ov at 177°
Core A.	1-in. test briquette	¼ lb.	1.5 min.	30 min
Core B.	4 x 4 x 6 in.	6 lb.	10 "	120 "
Core C.	12-in. cylinder x 8 in. diam.	40 lb.	75 "	overnig

Water-soluble and thermoplastic binders melting below 105°C. provid strong cores by this method of drying, and additional advantages accrue from the faster rate of drying, such as the elimination of c racks, etc. A change in design of plates and dryers will be neces as the moisture condenses as liquid water at the base of the core; plaster moulds might be satisfactory in this respect. See also Industrial Heating 13 479. 1946.

972. Crannell, R. W. Foundry 7/1947 75 (7) 66-9, 240-1.
ELECTRONIC CORE BAKING. Experimental results on core baking presented, on account of small space required and rapid baking, a dielectric unit is a desirable piece of supplementary equipment to foundry oven.

973. Dawson, J. Iron Age. 165. 18. 90-93. 4 May 1950.
ELECTRONICS SPEED CORE BAKING. Improvements in quality and speed the Allis-Chalmers Mfg. Co. plant.

974. Griffith, D. Western Metals 7. 8. 28-29. 8/8/1949.
SAND CORE BAKING BY DI-ELECTRIC HEATING. Illustr.

975. Wise, R. T., Moran, J. P. Materials and Methods, 23, 1307, 1946.
RAPID BAKING OF FOUNDRY CORES BY DIELECTRIC HEATING. The advantage of employing dielectric heating for baking cores are pointed out. One of the heating units illustrated is capable of baking approxima 360 lb. of cores/hr. with a power consumption of 25 kw.

76. Elliott, T. G. B.C.S.O.(N.A.) Ref.No.694.U.K.S.M. Memo No.61/50. D.S.I.R. (Confidential)
SOME NOTES ON A SYSTEM OF DIELECTRIC DRYING OF CORES AT THE CROMPTON AND KNOWLES LOOM WORKS, WORCESTER. MASS. The firm dries by this means a large number of small cores of widely varying types.

nfra-Red Heating

77. ---- Proc.Amer.Gas Ass.1944,26,235-243.
DRYING OF GREEN SAND MOULDS FOR LIGHT ALLOY CASTINGS BY INFRA-RED RADIATION. The paper describes experimental work carried out by Rolls-Royce Ltd., and the Derby Gas Light and Coke Co., on the drying of green sand moulds. Gas and electric infra-red heaters were compared in a series of tests. These tests are described and the results are presented. From these it seems that moulds can be satisfactorily dried by a radiant panel gas drier more efficiently than by an electric panel using tungsten filaments. For an actual mould, the performance of the gas fired panel was:- Time + 20 mins.; Heat - 12 cu. ft. gas (6,000 B.Th. U.): Condition satisfactory.

and (see also under Indus. Maths. General).

8. ---- Railway Age 125.(1).p.20.July 1948.Abstr. Railway Engng. Abstr.9/1948.No.3014 3121. p.231.
SAND DRYING UNIT.

. Bathgate, A. & Sons Brit.Pat.,559,928,10/3/44.
DRYING GRANULAR MATERIAL. Equipment is described for drying foundry sands.

. Brock, R. B. C.& I.22 p.299 5/1947.
INFRA RED DIRECT READING MOISTURE TESTER.

1. Dunbeck, N. J. Foundry Tr.Jnl.68 217 1942.
THE DRYING OUT OF SYNTHETIC SANDS. Additive agents reduced rate of drying, although this is not always a disadvantage. Fuel oil additions did not reduce the rate appreciably, and increased workability.

2. Glacier Metal Co., Liddiard, P.D. Brit.Pat.600,210,2/4/48.
IMPROVEMENTS IN THE CONTROL OF MOISTURE CONTENT IN SANDS USED FOR MOULDING. The moisture content in moulding sands during reconditioning, involving the periodical addition of a definite quantity of water to a definite quantity of sand, is controlled by passing an electric current through a circuit which includes the sand. The conductivity is recorded, and hence the moisture content of the sand, and the water to sand ratio, is adjusted according to the recorded conductivity. An apparatus for this purpose is described. (1 fig.).

983. Harris, N. E. P. Foundry Tr.Jnl.81 (26) 1947.
DETERMINING THE MOISTURE CONTENT OF SANDS.

984. Locke, C., W.Mich. Steel Foundry Co. U.S.Pat.2,466,453.5/4/49.
APPARATUS FOR TESTING FOUNDRY SAND. A self contained unit compre
a sample of foundry sand, and determines its temperature and its
moisture content (electrically).

Permeability of Cores

985. Calhoun Petrol Eng.18 N.ZL.103 1947 B.III.434. Sept.1948.
NEW METHOD FOR DETERMINING PERMEABILITY OF CORES. An apparatus fo
determining the permeability of a core sample to gases is describe
Equations to justify the procedure are given. Results confirm tha
permeability varies inversely with the mean pressure of gas, and
varies with nature of gas. The infinite pressure value is the sa
for all gases and liquids.

986. Fancher, G.H., Lewis, J.R. Adv.Paper,ACS Pet.Div.Mtg.Washington 1
FLOW OF SIMPLE FLUIDS THROUGH POROUS MATERIALS. By means of an
ingenious arrangement, the pressure drop through consolidated and
unconsolidated sand cores was measured. Oil, water and air were
fluids used. In the viscous region the pressure drop through unco
solidated sand of 31-39% voids is twice the value given in Rept.
B-197-19.

COAL

General Process, Coal

987. Anon. Iron Coal Trade Rev. 706-7, Nov.6, 1931.
DRYING COAKING COALS AT BARROW COLLIERIES. Experience with the Universal Drier.

988. Anon. Eng. & Boiler House. Rev.,45, 559,560,562, 1932.
PRE-DRYING OF COAL FOR COMBUSTION. Details of latest American practice; characteristics of specific coal drying equipment.

989. Anon. Coal Age,1939,44,No.10,49-53;Iron Coal Tr. Rev.1939,139,866.
HEATING AND COOLING PLUS SHAKING AND SQUEEZING OF COAL CHARACTERIZE FIATT DRYING SYSTEM.

990. Anon. Instn.Min.Engrs.-Memo No. 18 Nov.1935 6 p.
DRYING OF WASHED COAL. Disadvantages of wet coal; removal of moisture by drainage, de-watering screens or centrifuges; types of thermal dryers; fuel requirements; power requirements; total cost of drying; effect of heating on coal.

991. Anon. Engineering 141 n 3653 Jan.17 1936 p.74.
DRYING OF WASHED COAL. Brief review of memorandum issued by Utilization of Coal Committee of Institution of Mining Engineers discussing subject from every angle, including need for it, possibilities of available plant, and economic factors involved.

992. Anon. Chem.Met.Eng.6/1942,49,No.6,108.
A new dryer for the effective removal of surface moisture from sized coal has been tried out on actual installations and is now announced by the Link-Belt Co., 307 N.Michigan Ave., Chicago, Ill. The dryer, to be known as the Link-Belt "SS" dryer, combines mechanical dehydration with heat drying and is available for drying sized coal of 10 mesh and up. The unit comprises a drying chamber with perforated reciprocating-plate drying surface; coal inlet and outlet; hot air inlet from a coal-fired furnace; and an exhaust fan for drawing the hot air into the chamber over and through the bed of coal; down through perforations and reciprocating plates to the exhaust stack. Operation of the moving element is analogous to that of the shaker screen except that the perforations are small and are intended only for passage of drying air. Inasmuch as the coal passes through the dryer in a thin bed at slow speed, it is uniformly dried with low temperature air and discharged relatively cool. Comparatively little power is required for operation of exhaust fan and reciprocating plate. The unit is illustrated by an accompanying figure.

993. Anon. Extract from a report to Min.Fuel Pwr.an
U.S.Tech.Intell.Comm.; Iron Coal Tr.Rev.,
6 Dec.1946,153,1048.

TURBINE-TYPE STEAM HEATED COAL DRIER. Coal for drying is fed at the top and passes downwards on a series of horizontal metal discs mounte in a vertical, cylindrical, metal shell in such a manner that they ca be rotated. Each disc has a series of radial slots through which th coal is transferred to the disc below, the transfer being effected b fixed scraper plates. One important feature of the turbine drier, is claimed, is that there is no loss of dust and no auxiliary de-dusting apparatus is necessary, due to the low velocity of drying ga through the plant. There appears to be no appreciable degradation size of coal during drying. The heat required is 1,100 cal. per kg of water evaporated.

994. Anon. Colliery Engng.,Jan.1948,25,26-28.

COAL DRYING. These notes describe some of the drying processes use in Central Europe, dividing them into those that use indirect and direct heating. The processes include the use of a drying drum, of the aspirator or Rema-Rosin coal dryer for coal of fairly small size, the Büttner turbine dryer, Büttner rotary kiln dryer, and the Fleiss process.

995. Anon. Coal Age 54 (4) 96-102, 1949.

MAID MARIAN PREPARATION. Dual washing and dewatering plant raises efficiency at a Central Indiana mine. New type oscillator and firs commercial installation of a new heat dryer feature, with output of 500 T.P.H. Description of a "Verti-Vane" dryer, consisting of two series of opposed conical shelves, and an outer casing forming the ho air chamber.

996. ---- C.I.O.S. Rept. No.XXXIII.

15. Coal Carbonisation. Drying. Briquetting.
16. Gas Heated Rotary Dryers.
17. Coal Dryers. Turbine Type at Büttner-Werke. Statistics given.

997. ---- F.I.A.T. Final Report 634.

COAL PREPARATION: WASHING, DRYING, DE-DUSTING, SCREENING ETC.

998. ---- B.I.O.S. Report No.1760. Part 1. Sect.3.
84-147.

DESCRIPTIONS OF GERMAN COAL DRYING PLANT. Accompanied by numerous diagrams.

999. Baragwanath, G.E., Recent Advances in fuel Technology. Com
Rogers, L.J., Urie, R.W. Australia May 1950. pp.146-152.

COAL DRYING. Flash Drying of Washed Screenings.
" " " Bituminous Coal.
Drying in a Fluid Bed.
Fleissner Process.
Drying Lignite in the Mill for Steam Raising. (It appears that flas drying makes the lignite easier to crush).
Illustrations and Diagrams.

000. Cudworth, Hertzog U.S. Bureau of Mines Inf. Circular 7009. Apr. 1938.
DE-WATERING AND DRYING OF COAL.

001. Chapman and Mott Chapman & Hall (Ldn.).
THE CLEANING OF COAL. Chapter 26.

002. Chapman, W.R., Needham, L.W. J. Institute of Fuel. 24 135. 51-60. March 1951. Combustion 23(8) 54-5. Feb. 1951.
THE THERMAL DRYING OF COAL. The reasons for drying coal and the factors involved for different purposes. Efficiency considerations, tables of performances and costs for various types of dryer. Description of modern equipment, and numerous diagrams of various types of equipment.

003. Dress, L. Min. Congr. J., June 1945, 32, No. 6, 34-5.
DRYING COAL THERMALLY AND MECHANICALLY. The fundamental methods of removing moisture from coal are described and the particular advantages of each and the uses to which each is best adapted are discussed.

004. Farnham, R. V. Colliery Guardian 149 n 3858 Dec. 7 1934 p. 1043-5.
DRYING OF COKING COALS. Influence on carbonization; reducing ash and moisture; thermal aspect; coking time; bulk density; coal drying; ovens of old design.

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NEW METHOD OF DRYING COAL. Equipment of horizontal design with disc-shaped rotating cylinders. The coal progresses freely, and perforated discs ensure uniform contact with the drying gases.

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DIE TROCKNUNG DER KOHLE. Methods of drying coal, particularly bituminous coal; steam drying; types of driers.

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REVIEW OF THE LITERATURE ON THE FUEL INDUSTRY IN 1949. Under various headings, incl. Peat, Coal.

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RECOVERY AND DRYING OF COAL FINES. Refers to the normal working of the coal washeries of the Powell Duffryn Collieries Ltd.

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DRYING OF COAL. A review, dealing with the occurrence of water i coal, the moisture-content requirements of coal consumers and the various methods of drying coal. A table summarises the methods u to dry coal for special purposes and gives some indication of the moisture reduction that can conveniently be achieved. Costs of drying and a summary of existing and potential methods of drying c are given. The direction of development of new techniques is sugg

1010. Lamprecht, E. Braunkohle 30,1107-12,(1931) Dec.26.
MEASUREMENT OF FLOW OF COAL IN SEPARATE TUBES OF TUBE DRYERS. DRY OF UNFAMILIAR DESIGN. Drying phenomena in tube dryers are investi ted and results compared with those of plate dryers. Means of ov coming difficulties met with in tube dryers.

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METHODS AND EQUIPMENT FOR DE-WATERING AND DRYING WASHED COAL. Procedures and equipment are described, tables and charts are give shewing operating data and results with various sizes of coal. So empirical methods for determining the types of equipment to be use in solving specific moisture-reduction problems are presented.

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THE THERMAL DRYING OF FINE COAL. The results of an experimental survey of the drying of coal in several types of dryer.

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Coal Tr.Rev.1941,142, 447.
HEAT-DRYING BITUMINOUS COAL. A description of an improved screen dryer designed to dry down to 0 size, to obtain a thorough drying a comparatively wide size range to keep power down to a minimum, a to eliminate the effluent problem. The screen consists essentiall of a multiple-deck screen suitably sealed and enclosed in a steel and arranged so that the hot gases are drawn upward through the co bed.

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THERMAL DRYING OF COAL BY WASTE HEAT. Description of the process drying coal below 9 m.m, in a rotary dryer by means of waste heat f the ovens. Performance data given.

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UNIVERSAL DRYER. TYPE C. Report of tests during week ending 6 June 1931 at the Barrow Collieries, Barnsley.

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CLEANING AND DRYING PLANT FOR FINE COALS AT DUTCH STATE MINE, MAURIES.

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Iron Fireman Mfg. Co.
DRYER FOR PNEUMATIC FEED COAL STOKERS.

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THE DRYING OF BROWN COAL, (LIGNITE). 146 Refs.

1026. ---- B.I.O.S. Rept. No.162.
BROWN COAL HANDLING PLANT AT COLOGNE AREA. Includes dryers for briquetting.

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DRYING AND L.T. CARBONISATION OF BROWN COAL IN LURGI SPUHLGAS RETOR
Drying of Brown Coal from 48 to 12% M. in The Umlauftrockner, by Buttner Co. Full diagram of Carbonisation Plant, including the pneumatic drying section. Short description of the drying process (gases at 1000^0 - 1200^0C.) Economic aspects and flow sheets.

1028. ---- B.I.O.S. Report 1761. Part 1. Sect.3. p.84-149.

METHODS OF AND EQUIPMENT FOR DRYING.
1. Plate, vertical, indirect steam dryers.
2. Rotary tubular dryers.
3. Circulatory gas and waste flue gas dryers.
4. Mill dryers. Direct gas heating.
5. Flash, fleissner, direct steam drying. Costing Systems. Dust recovery, Safety devices, Lubrication.

1029. ---- C.I.O.S. Report No.XXXII-14.

BROWN COAL. VARIOUS PROCESSES AT ERDOL A.G.

1030. Agde, G., Hubertus, R. Braunkohle 31 Nos. 50 and 51 Dec.10 193 p.877-81 and Dec.17 p.897-900.

INVESTIGATIONS OF DEHYDRATION PROCESSES PRECEDING LOW-TEMPERATURE DISTILLATION OF LIGNITE. Volume curves of dehydration; capillary phenomena; dehydration tests; capillary structure and distillatio conditions.

1031. Baldauf, K. Braunkohle 32 717-729. 30 Sept.1932.

THE DRYING OF LIGNITE COAL.

1032. Berthelot, C. Genie Civil 106 n 25 June 22 1935 p.617-

LA DESSICCATION DU LIGNITE, A LA SOCIETE DES MINES DE PETROSANI (ROUMANIE). Description of lignite drying plant of mining company of Petrosani, Roumania, for treatment of 100,000 tons of lignite pe year.

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DRYING OF LIGNITE WITH CONDENSATE RECOVERY. Relation of distillate recovery to volume and temperature of cooling water and dewpoint of vapors; simple and accurate method developed for determining performance of drier, and example given of utilization of vapor for heat supply in power plants.

1034. Cooley, A.M., Jr., Lavine, I. Indus. & Eng.Chem. 25 n 2 Feb.19 p.221-4.

DEVELOPMENT OF DAKOTA LIGNITE. Continuation of studies indexed in Engineering Index 1930, 1931 and 1932, from issues of November and December 1930, January and February, 1931 and January and August 19 various authors; oil steam atmosphere for dehydrating Dakota lignit apparatus and procedure; results of tests. Bibliography.

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IMPROVING LIGNITE TUBE DRIERS BY ELECTRIC ARC WELDING. It is shown that rivets are not elastic, but undergo permanent reshaping, as they apparently are weakest part in structure; against this, welding shows such high strength that stretch relative to 8 m. length of tubes is greatly diminished.

36. Erimescu, P. Braunkohle, 30, no.36, Sept.5, 1931, pp.797-801, 3 figs.

CONTROL AND SUPERVISION OF DRYING OF CRUDE LIGNITE IN PLATE DRIERS. Factors which affect drying; methods of control. Discussion in Braunkohle 30 (48) Nov.28. 1931 pp.1036-1041.

37. Forni, S. A., Ed. Impianti Indust. Ingg. di Bartolomeis B.P.620,621, 23.1.47. It., 3.2.41.

DRYING OF [SOLID FUEL]. Flue gases pass through the packed fuel, viz., lignite, their entry temperature being controlled by recycling a portion of the exit gases.

38. Gropp, F. Feuerungstechnik 25 n 2 Feb.15 1937 p.41-2.

FLUE GAS AND STEAM DRYING IN LIGNITE CARBONIZING AND BRIQUETTING PLANTS. It is pointed out that flue gas circulating drier has properties that justify its use; steam drying, fresh gas, flame drying and flue gas drying, and combination of two drying systems, are compared; steam drying is most economical when surplus back pressure can be utilized.

39. Gropp, F. Braunkohle 36 n 9 Feb.27 1937 p.129-37.

FUEL AND HEAT REQUIREMENT OF FLUE GAS DRYING OF CRUDE LIGNITE. Comparison of flue gas drier system and steam drying with back pressure power generation in briquetting plants; as cost of flue gas drier with condensation steam generation is lower than that of steam drier with back pressure power generation, former is recommended for plants which have no demand for electric power generated in steam drier.

40. Kraushaar, O. Braunkohle, 1943, 42, 173-9, 199-203.

PRE-DRYING OF CRUDE BROWN COAL. After discussing the difficulty of working with wet coal especially in filling the dryer and the economic advantage of pre-drying the author gives an illustrated description of the plant installed at the Dora-Heleno works for pre-drying by means of flue gases. Experimental results and the heat balance are discussed. Suggestions are made for improving the bunker emptying and for controlling the drying. It was found that pre-drying even in the case of normal moist coal considerably increased and cheapened the throughput, and its introduction throughout the brown coal industry is recommended.

1041. Kraushaar, O. Z. Ver. deut. Ing. 1943, 87, 727-30; Chem. Ab
1945, 39, 1526.

DRYING OF CRUDE LIGNITE. Pre-drying of lignite even if only a fe
H_2O removed facilitates the briquetting markedly; for each % H_2O
removed, the briquette yield increases by 5%. The H_2O removal m
only be reduced from 58 to 55%. The pre-drying also reduces the
sticking tendency of the lignite. A drying installation is desc
as built into a briquetting plant. Operating data are given.

1042. Lamprecht, E. Braunkohle, 30, no. 52, Dec. 26, 1931,
pp. 1107-1112, 5 figs.

MEASUREMENT OF FLOW IN INDUSTRIAL TUBES OF TUBE DRIERS. Drying
phenomena in tube driers are investigated and results compared wi
those of plate driers; means of overcoming difficulties met with
tube driers.

1043. Mayer, M. Braunkohle, 1939, 38, 589-607.

DEVELOPMENT OF PLATE DRYERS IN BROWN COAL BRIQUETTE FACTORIES. I
only recently that the plate dryer has been able to compete with
tube dryer which is some 20-30% cheaper to instal. The means by
which this equality has been achieved are shown by an illustrated
survey of the development of the plate dryer the advantages of th
type of dryer for use in briquette factories are discussed and fe
and driving mechanisms are described.

1044. Mueller, E. Braunkohle 72, 805-11, 826-31 (1935).

DRYING OF LIGNITE COAL.

1045. Piatscheck, H. Braunkohle, 1940, 39, 151-157, 161-3.

EXPERIENCES WITH CIRCULATION DRYERS AT OFFLEBEN. A detailed
description with illustrations is given of a Büttner circulation
dryer in use at the Offleben gasworks for drying brown coal for
briquetting.

1046. Schultz, F. Braunkohle, 1939, 38, 393-397, 415-41

OPERATING EXPERIENCE OF THE CONDUCT OF A (BROWN-COAL) DRYING SYST
WITH RECORDING APPARATUS FOR DETERMINING WATER CONTENT. Details
are given of the operation of a brown-coal drying plant provided
with Velten's apparatus for automatically recording the H_2O conten
of the coal. The apparatus, which has functioned satisfactorily
four years, utilises the variation in the capacity of a condenser
between the plates of which the coal passes. By using medium-
instead of high-frequency current some disadvantages of this metho
of determining H_2O content are eliminated. (From Brit. Chem.
Physiol. Abstr. B. 1086. 1939).

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plate.

PROCESS OF DEHYDRATING LOW-GRADE FUELS, ESPECIALLY LIGNITE. Referen
made to report of investigations of U.S. Bureau of Mines for

determination of slacking characteristics of coal; reference also made to other reports; processes of lignite drying.

e-watering

048. —— B.I.O.S. Report 611.
COAL. USE OF WASHERY SLURRY AS BOILER FUEL IN THE RUHR.

049. Crawford, A., Reed, W. Conf. on Utilisation of Small Coals. Steam Eng. 13 112. 1944.
DE-WATERING OF DUFFS AND SLURRIES.

050. Edwards, J. H. Coal Age, 46, No.11, 47.
CENTRIFUGAL DRYING OF FINES. A description of a continuous centrifugal dryer installed by the Sentry Coal Mining Co. Madisonville, Ky., which recovers 20 to 25 tons per hour of minus 10-mesh coal from slurry, reducing the surface moisture from 30-5%. Fines from the de-watering and rinsing screens constitute the feed to the dryer, this material formerly being wasted from the settling cone. (From Colliery Eng. 1942, 19, 111).

051. Gallagher, R. T. Trans.6th Anthracite Conf. Lehigh Univ. 11-23. May 1948.
DE-WATERING OF FINE SIZE ANTHRACITE COAL. Describes results of tests on the Weco shaking screen.

052. Gandrud, B.W., Riley, H.L. U.S.Bureau of Mines Investigation 4306. July 1948.
COMBINATION CLEANING AND DE-WATERING PROCESS FOR TREATING FINE SIZES OF COAL. Preliminary report.

053. Graff, G. Gluckauf.86 5.89-92 Feb.1950 Colliery Eng. 27 p.298 1950.
DEVELOPMENT AND SIGNIFICANCE OF PRELIMINARY DE-WATERING OF FINE COAL IN GERMANY.

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DE-WATERING OF WASHED SMALL COAL. A discussion of technical and economic aspects of drying by static drainage, jigging sieves, vacuum filters, heating and centrifugal treatment.

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THE DE-WATERING OF WASHED FINE COAL FOR USE IN COKE OVENS OR FOR PRODUCTION OF AGGLOMERATES.

1056. Procat, F. V.D.I.Zeit.74, 1729-34, (1930) Dec.20.
DE-WATERING OF COAL AND CLARIFICATION OF WATER BY CENTRIFUGING.
Mathematics of process of separating solids and liquids by centrifuging and results of experiments to determine influence of variations in centrifugal force, in duration of centrifuging and in particle size, on degree of de-watering; no. of centrifuges and th operating results, with particular reference to de-watering of fine coals.

1057. Richardson, A.C., Lyons, Q.R. Min.Eng. 137 (3) 381-4. March 19
OPERATING DATA FOR BIRD CENTRIFUGE APPLIED TO THE DE-WATERING OF COAL.

1058. Rzezacz, P. Glueckauf 73 n 22 May 29 1937 p.496-507
DRYING OF FINE COALS BY CENTRIFUGING. Author reviews various mode types of centrifuges used for drying fine coals and gives account o experiences gained with them.

1059. Truempelmann, E. Montanistische Rundschau 26 n 1 Jan 1 1
(supp.) 6 p.
SIEVLESS DE-WATERING CENTRIFUGE FOR SLURRY AND FINE COALS. Produc to be dried is not projected against sieves, but against fixed wall of drum rotor, centrifuged water flowing off through de-watering cavities or orifices projecting into coal; this obviates sieve wea and keeps percentage of solids in waste water very low. See also English translation in Colliery Guardian 148 n 3820 Mar 16 1934 p.4

1060. Yancey, H.F., Geer, M.R. Amer.Inst.of Min. & Met.Engrs. Tech.Publ
2351.1948.
THICKENING BY CYCLONE. 99% recovery of solids above 200 mesh, but o 60% of solids below 200 mesh.

Mill and Pneumatic Drying

1061. Anon. Archiv.fuer Waermewirtschaft, 12, no.5,
May 1931, pp.147-148, 4 figs.
PREPARATION OF LIGNITE FOR PRODUCTION OF PULVERIZED FUEL. Preparat of raw lignite by drying; pneumatic circulatory drying; advantages of process; temperature and pressure conditions; results and efficiency as compared with drum drying.

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CIRCULATING DRIER FOR FINE COAL. Abstract translated from Technisc Blaetter of Deutsche Bergwerks-Zeitung, date not specified, describi Rema-Rosin modification of Buettner pneumatic drier for drying fine coal, in which coal is simultaneously dried and conveyed by upward current of hot furnace or waste gases.

3. Anon. Coal Age, 1940. 45. July. p.70.
DRYING SMALL COAL. The C.E. Raymond flash-drying system has been developed by the Combustion Engineering Company, Chicago, for the drying of 5/16-in. and smaller coal.

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GAS SUSPENSION CONTINUOUS DRYER FOR DRYING BROWN COAL FOR BRIQUETTING. An illustrated description is given of a fire gas dryer for brown coal, in which the material to be dried is brought into direct contact with the drying gases. Working conditions and results are compared with those of steam drying and dimensions, and costs of the continuous plant are discussed. From Glückauf 1938. 74. 912.

5. Brownlie, D. Combustion 3 n 7 Jan.1932 pp.37-39 and 51.
COAL DRYING FOR COMBUSTION. Pre-drying of pulverized coal is no longer practiced except with fuels having very high moisture content; rapid advances made in mill-drying have made this method almost universal; in burning lignites and coals high in moisture, it is still necessary in most cases to effect at least partial drying before coal enters mills; characteristics of two driers recently developed in England.

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MILL DRYING OF PULVERIZED COAL. Outline of mill drying operations; heat required for drying coal; chart for determining water vapor content of air at different temperatures and humidity.

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MILL DRYING AT LAKESIDE. Review of practice at Lakeside Station in which flue gas as drying medium is taken from air heater; test results, with both heat and moisture balances included; advantages of mill drying for bin and feeder system are: lesser first cost, greater safety due to blanketing with CO_2, operating and maintenance costs less, and improved boiler room efficiency.

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Comb,Eng.Co.Chicago.
FLASH DRYING. Includes data for flash drying of coal (1600 B.T.U./lb. H_2O); full diagram of a pneumatic dryer for coal.

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THE MILL UNIT AS HIGH DUTY DRYER. Numerous curves and diagrams accompanying the account of mill drying. Sizing, pneumatic drying and cyclone separation.

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DRY GRINDING, PARTICULARLY OF WET COAL. With the mill is connected a wet separator in which is collected a slime comprising H_2O and coal dust. This slime is partly de-watered and the residue is returned to the mill for further vaporization of the water.

1071. Parry, V.F., Goodman, J.B., Wagner, E.O. Amer.Inst.Mining & Met.Engrs.Mining Eng. 186 (4) 89-98 1949. Tech.Publ.2567-F.
DRYING LOW RANK COALS IN THE ENTRAINED AND FLUIDISED STATE. The authors have studied the drying of coal in a pneumatic dryer and in fluidised-solids dryer, both of semiworks size. Considerable data and design information were presented. The pneumatic dryer handled 16 mesh or smaller coal at 85% thermal efficiency and the fluidised solids dryer - 8 mesh at 35 to 90% efficiency. Also in Trans.Amer. Inst. of Mech Engrs. 184 89. 1949 and 187 974. 1950. A summary of 1949 investigations is given in Min. Eng. 187 (9) 1950 p.974-982.

1072. Oyvin, N.L., Racheyev, M.P., Vinogradov, K.A. Izvestiya Vsessoyuznovo Teplotechnicheskovo Institute n 8 (67) Aug. 1931 p.14-39.
RESULTS OF ORIGINAL TESTS ON DRYING OF MOSCOW BASIN COAL AND OF CUT PEAT IN SUSPENDED CONDITION. Report on study of pneumatic drying o coal, preliminary to its use as pulverized fuel. (In Russian).

1073. Reavell, B. N. Inst.of Fuel Conf.June 1947.pp.567-577.
DRYING OF FINE COAL IN A THERMO-VENTURE DRYER.

1074. Seyfritz, H. Glückauf, 14 Aug.1948, 81/84, 563-565.
COAL DRYING IN PULVERISING PLANT. Descriptions are given of auxiliary dryers for installing before central mills for pulverising coal where the original plant cannot handle coal of such high moistu content as must be accepted under present day conditions and for attaching to mill firing installations.

1075. Thou, A. Colliery Guardian 145 235-8 Aug.5.1932.
THE REMA-ROSIN PNEUMATIC DRYER.

1076. Weiss, M. Montanistische Rundschau, 23, no.1, Jan. 1931, pp.5-10, 5 figs.
DRYING OF COAL IN PULVERIZER. In forms of mill used for pulverising coal, temperature of mill, and consequently of coal, rises considerably; this evaporates some of moisture in coal, which is removed by air used for separating powder from incompletely ground material; describes "suspension drier" and several pulverizers in which this principle is employed. See also brief translated abstract in Iron, Steel and Indus. Fuel, no. 37, Jan. 1931, p.2.

Fleissner Process

1077. —— B.I.O.S. Report No.176 p.129.
The Fleissner process is suitable only for certain hard brown coals. It is a batch process and reduces moisture from 50% to 15%. Screen coal, 10 to 250 m.m., is preheated in an autoclave with exhaust stea for 25 mins. and then with steam at 25 atm. for 1 hour. The steam is then passed on to preheat the next autoclave. A 70% vacuum is then applied for 15-20 mins. by a high pressure exhauster and water

runs away freely. The discharge is siliceous and causes scaling. Superheated steam must not be used since it takes water from the outer layers and the coal disintegrates.

078. ---- B.I.O.S. Report No.1874. 27 pp.
STEAM DRYING OF COAL. An illustrated account of the Fleissner process for drying lignite. Table of analyses of various sizes after drying. Processes at various centres are given. Results of an interview with Dr. P. Rosin.

079. Bainbridge, J. R. Sth.Austral.Dept.Mines.Min.Rev.87 Apr.1949.
RESEARCH INTO FLEISSNER DRYING AND SOUTH AUSTRALIAN COAL. Study of Fleissner process has been studied at Melbourne University since 1944 for drying low rank coals. The various aspects are discussed and directions for future development are outlined. A desirable arrangement is for the Fleissner process to be an integral part of a power station.

080. Bainbridge, J.R., Satchwell, K. Fuel,Mar.-Apr.1947,26,28-38.
EXPERIMENTS IN FLEISSNER DRYING VICTORIAN BROWN COAL. Treatment of coal samples from the Latrobe and Yallourn seams in the Latrobe valley, Gippsland, by the Fleissner process establishes the fact that Victorian brown coals can be dried to a useful degree by that method. The results presented indicate clearly the important effect of treatment pressure both on drying and on strength.

081. Cooley, A. M. Jr., Lavine, I. Fuel 11 n 12 Dec.1932 p.428-34.
SOME CHARACTERISTICS OF LIGNITE DEHYDRATED BY STEAM. Study shows that not all Dakota deposits are suited for processing with steam at pressures up to 15 atm; successful dehydration is always accompanied by decided sorption of steam during dehydration; shrinkage in volume during dehydration has been found to vary from 18% to 32%.

082. Formaenek, J. Braunkohle, 30, Nos. 40 and 41, Oct.3, 1931, pp. 874-881, and Oct.10, pp.893-900, 6 figs.
HEAT TECHNOLOGY OF LIGNITE DRYING ACCORDING TO FLEISSNER PROCESS. Determination of temperature with Fleissner process; equation for heat equilibrium; experiences in Koeflach plant.

083. Harrison, F. H. Min.Rev.S.Austral.Dep.Mines,1946,No.83, 47-70.
INVESTIGATIONS INTO STEAM DRYING OF LEIGH CREEK COAL. The method of steam drying by the Fleissner process was investigated thoroughly by the erection of a pilot plant capable of treating 1,800 lb. of coal working 16 hours per day. The pilot plant was erected at I.C.I. Alkali (Australia) Pt. Ltd. works at Osborne.

1084. Harrod, J.W., Milne, K.H. S.Austral.Dept.Mines Rev.88.72-95.1948.
STEAM DRYING OF COAL. An account is given of a visit to plants at Koflach in Styria and at Haberskirk in Bohemia. Construction and operating costs are described, recommendations for installation at Leigh Creek are made and for avoidance of break up.

1085. Kaiser, F. Braunkohle 35 n 5 and 6 Feb.1 1936 p.65-
and Feb.8 p.85-8.
DRYING OF CRUDE LIGNITE FROM UPPER PALATINATE BY FLEISSNER PROCESS. Indexed in Engineering Index 1935 p.613 from Zeit des Bayerischen Revisions-Vereins, July 31, Oct. 31 and Nov. 15 1935. The object i to retain lump form. Details of Panholz plant and operation.

1086. Klein, H. Fuel, 10, no. 9, Sept.1931, pp.385-389,
5 figs.
THE DRYING OF LIGNITE BY THE FLEISSNER PROCESS. Product is lump coa of high calorific value and good storing qualities; coal contained i raw material is preserved in this process; process fulfills same function with woody lignites as briquetting does with bituminous lignites; it will probably become important in countries poor in fuels of high calorific value, but which possess considerable deposit of lignitic coal. Indexed in Engineering Index 1930, pp.1009-1010, from Internationale Bergwirtschaft und Bergtechnik, Dec.15, 1930, 377-382.

1087. Lavine, I., Gauger, A.W., Indus.and Eng.Chem., 22, no.12, Dec.1930,
Mann, C.A. pp.1347-1360, 11 figs.
STUDIES IN THE DEVELOPMENT OF DAKOTA LIGNITE - DRYING OF LIGNITE WITHOUT DISINTEGRATION. Results of extended study on steam drying o this lignite; work consisted in subjecting lignite to following stages; preheating period with saturated steam directly in contact with coal; heating period, in which coal mass is brought to temperature of steam; release period, in which steam pressure is brought to atmospheric; and aeration period, in which blast of air is passed over coal mass.

1088. Parry, V.F., Harrington, L.C., Trans.Amer.Soc.Mech.Eng.1942, 64,
Koth, A. 177-83.
PREPARATION OF STABLE NONSLACKING FUEL BY STEAM-DRYING SUBBITUMINOUS COAL AND LIGNITE. Subbituminous coal and lignite, as mined, contain 20 to 40 per cent. moisture, which limits their markets due to slacking and to the costs of transporting this water. By drying the fuels with saturated steam at 400 psi pressure by the Fleissner proce described in this paper, the free-moisture content may be lowered to to 8 per cent, reducing slacking and increasing the available market. The properties of the dried fuel and processing data are presented an the construction and operating costs of plant are estimated.

89. Saunders, W. D. S. Austr. Dept. Mines Min. Rev. 86. 1948.
STEAM DRYING OF MOORLANDS COAL BY FLEISSNER PROCESS. Coal at 57% M. content was preheated by exhaust steam for 10 mins., then by live steam, 20 mins., heating 40 mins release 10 min., vacuum 15 min., aeration in autoclave - nil. 487 p.s.i. M. content reduced to 18%.

90. Skutl, V. Braunkohle 31 n 53 Dec. 31 1932 p. 932-4.
NEW DRYING PROCESS FOR LIGNITES WITH HIGH WATER CONTENT. Coal is dried, without loss of original shape or strength, by circuit of superheated steam under pressure; process permits utilization of steam formed from water content of coal.

91. Skutl, V. Berg- u Huettenmaennisches Jahrbuch 84 n 1 Mar. 27 1936 p. 13-38.
PHENOMENA OCCURRING DURING STEAM PRESSURE HEATING OF LIGNITE IN DRYING PROCESS. Results of tests with dewpoint tensiometer; effect of following factors; gases and coal solutions at room temperature, bivalent and trivalent bases and neutral electrolytes; autoclave tests. Bibliography.

ash Pulverisation

92. ---- C.I.O.S. Report XXXII/14 p.2.
DRYING SOFT BROWN COAL BY COMBUSTION GASES. Break up to 240 mesh, with evolution of steam.

93. Inst. of Gas Technology B.P. 591,921/1947.
APPARATUS FOR AND METHOD OF COMMINUTING A PERMEABLE MATERIAL (such as coal). Apparatus for flash pulverisation is described.

94. Hoffman, H. D. Naval Tech. Mission in Europe, Letter Rep. 137-45 (S); U.S. Dept. Commerce, Office Tech. Serv., PB 22497, 72pp., $1.00.
LURGI MAHLTROCKNUNGS PROCESS (PULVO-DRYING). A process for drying and disintegrating simultaneously in suspension, a high water-content coal, mostly of the lignite type in view of its subsequent agglomeration in briquette form. The procedure was developed by Krupp, A. G., Essen in co-operation with Lurgi Gesellschaft für Wärmetechnik m b.H. Frankfurt Main. Full details in German with many illustrations and drawings are given in enclosures. The process has some real merit, but is somewhat complicated according to the report.

5. Parry, V. F., Wagner, E. O. Colorado School of Mines Quarterly 45 (28) 57-66. 1950.
FLASH DRYING OF MISSOURI BASIN COALS.

6. Yellott, J.I., and Singh, A.D. Power Plant Engng, Dec. 1945, 49, No. 12, 82-6.
COAL ATOMISER - A NEW METHOD OF PULVERISING AND DRYING COAL. This device based on the explosion principle used in making "puffed" cereals,

is composed of a hopper, where crushed coal can be stored under pressure; a means of introducing this coal at a controlled rate in the upstream side of a nozzle through which steam or some other compressed gas is flowing; and the nozzle itself which, because o the pressure range employed, first converges to a throat and then diverges to an appropriate size. A cyclone separator is provided that the product can be collected and analysed while the exhaust st goes to the atmosphere or to a condenser. The influence of steam pressure, recycling of the product, etc. is considered. The appara can be used for lignite and air can be substituted for steam. Moisture is reduced from 37% to 4%.

Rotary and Turbo Dryers

1097. Anon. Engineer 153 n 3968 Jan. 29 1932 p.128.
VERTICAL COAL DRYER. Apparatus developed by Brightside Foundry an Engineering Co., Sheffield, comprises narrow casing in which there housed number of rotary "spiders"; driven by single continuous cha coal fed into machine cascades from one spider to next below; unti discharged on conveyance; hot air is admitted at bottom of casing sucked out at top by fan.

1098. Anon. Iron Coal Tr. Rev., 7 June, 1946, 152, 1025.
APPLICATION OF ROTARY LOUVRE DRIERS. The application of a rotary louvre drier built and installed by Dunford and Elliott (Sheffield) Ltd., at the Grimethorpe Works of the Standardized Pulverised Fuel to the drying of small coal is described. In this drier the heate gases are brought into intimate contact with the wet surfaces of th coal and it would seem that the rapidity with which the water is evaporated does not allow the coal to absorb any excessive degree o heat; in point of fact, under actual test with the in-going heatin medium at a temperature of 480 deg. C., the maximum temperature of dried fuel did not exceed 78.6 deg. C.

1099. ---- Colliery Eng. g. 25 26-28 Jan. 1948.
COAL DRYING. Buttner Rotary Kiln Dryer.

1100. Boehm, G. Braunkohle, 30, no. 13, Mar. 28, 1931, pp. 247-252, 6 figs.
OPERATING EXPERIENCES WITH FLUE-GAS CONSTANT-CURRENT DRUM DRIER FOR DRYING LIGNITE. Advantages and disadvantages of this type of ligni drier in comparison with steam tube driers.

1101. Bondarenko, K. V. Izvestiya Vsessoyuznovo Teplotechnichesk Instituta n 8 (67) Aug. 1931 p.4-14.
DRYING OF MOSCOW BASIN COALS. Reports on experimental study; drie of drum type was used; Russian crude oil was used as fuel. (In Russian).

02. Fritsche, K. Z.Ver.deut.Ing.1939.83,277-80.
THE TURBINE DRYER IN BROWN COAL PREPARATION. An illustrated description is given of the turbo dryer introduced in brown coal refining works to reduce the swelling of brown coal briquettes. The advantage of this type of dryer and practical experience with it are discussed.

03. Rammler, E., Brietling, K., Braunkohle,1942,41,533-8,547-52,561-4.
Leo, C.
EXPERIMENTAL DRYING OF CRUDE BROWN COAL ON THE TURBINE DRIER. The turbine drier of Fritzsch successfully dried crude brown coal of various sources in 100-110 min. from 52.1-59. to 16.2-18 water; if desired, 5-8% or 0% can be obtained. The temperature of the circulating gas is 250-380°. The initial drying is rapid from the 7th plate on it decreases linearly with time, probably because of the evaporation of capillary water. Only slight disintegration occurs during drying, probably on account of a shrinkage process. Zylites did not cause difficulties. Numerous diagrams and calorific data are given. (From Chem.Abst.1943,37,5220).

04. Seidenschnur, F. Braunkohle, 30 No.35,Aug.29,1931,pp.778-780.
OPERATING EXPERIENCES WITH FLUE-GAS DRUM DRIER. Author's experiences with producer-gas heating of flue-gas drum drier and economic principles and conditions governing this type of firing.

ying by use of Organic Liquids

05. Agroskin, A.A. and Loskutova, E.N. J.Appl.Chem.(U.S.S.R.),1946, 19,349-362; Battelle Libr. Rev.,1947,No.1,19.
INFLUENCE OF SURFACE TENSION OF LIQUID HYDROCARBONS ON THEIR EFFICIENCY IN WEATHERING THE COAL CHARGE. Dependence between surface tension and efficiency of wetting of coal by such liquid hydrocarbons has been investigated. Results show that the reagents possessing lower surface tensions produce more efficient wetting.

06. Burr, A.C., Offelt, W.H., Proc.N.Dakota Acad.Sci.2 32-36 1949.Chem.
Kamps, T.W. Abstr.4831.25/6/1949.
THE RATE OF DRYING OF LIGNITE IN HOT OIL AT 315°F. Lignite, 1 to 4 inches diam. is dried by immersion in hot motor oil, S.A.E.20 at 310-20°F. The final moisture content depended upon time and was a function of diameter of equivalent sphere. % Moisture removed, Y.

$$Y = \frac{9.28x/D^{1.625}}{1+0.01(9.28x/D^{1.625})}$$

where x is the drying time in minutes and D is the diameter of equivalent sphere. Thus the time to dry can be calculated.

1107. Anon. Brit.Clayworker, 1940, 49, 45.
SHOULD COAL BE WETTED? Careful investigation of the effect of wett coal or using wet fuel shows that there can never be a direct gain i heat resulting from the wetting; on the contrary there is always a loss, which may be serious if too much water is added. Any advantag derived from wetting coal are always indirect and it is often very difficult to know whether they are gained in any particular boiler o kiln. There is a direct loss of heat in evaporating the water, but the better burning of the fire (through the lesser clinkering of the grate) is so beneficial that it outweighs the loss of heat. The mos desirable amount of moisture lies between 3 and 5%.

1108. Anon. American Institution of Mining Engineers, Coal Preparation Committee. (1947, 9 pp.).
ESTIMATES OF MOISTURE INCREASES DUE TO WATER SPRAYING COAL FOR DUST CONTROL. This report consists of discussion and data on (a) percent ages of dust in bituminous coals, (b) moisture increases due to spray for dust control in mines or plants by methods which have proved sati factory for periods of one to five or more years, and (c) suggestions for research.

1109. Benade, W. Braunkohle 31 n 48 and 49 Nov.26 1932 p.845-8 and Dec. 3 p.864-8.
RELATION OF VOLUME OF DIFFERENT LIGNITES TO WATER CONTENT IN DRYING C LIGNITE. Theoretical and experimental study; results and derivation formulas.

1110. Bielenberg, W. and Zdralek, O. Braunkohle, 1929, 28, 41-43.
STUDIES ON THE DIELECTRIC BEHAVIOUR OF BROWN COAL, AND ITS RELATIONSH TO THE WATER CONTENT OF THE COAL. The dielectric constants of 7 different samples of brown coal, of montan wax, and of mineral resin were measured on cylindrical briquettes (50 mm. diameter and 10 mm. long) by means of alternating current of three different frequencies. The values for the wax and resin were found to be small, but the capacity of the brown coal samples, which contained different proportions of water increased with increase in the water content. This increase became considerable beyond the point where the coal was saturated with hygroscopic water; below this point the capacity vari little with the water content. The authors suggest that these inves gations when completed will give valuable information on the structur of coal.

1111. Bond, R.L., Griffith, M., Maggs, F.A.P. Faraday Soc.Discussions, No.3, "Interactio of water and porous materials", 1948, 29-40 abridged in Nature, 24 Apr. 1948, 161, 629-63
SOME PROPERTIES OF WATER ADSORBED IN CAPILLARY STRUCTURE OF COAL. Th relation between liquid water and adsorbed water is discussed in the light of current theories. Whereas capillary condensed water might

expected to possess the properties of the bulk phase, measurements of the dielectric constant and volume changes on cooling coal saturated with water vapour show no evidence of a sharp freezing point. The significance of the angle of contact between liquid water and saturated coal is discussed; measurements of the free-energy decrement on wetting saturated coal suggest that the angle of contact is about 90^0 but the value must in fact be less from the flotation experiments. It is concluded that a phase difference exists between water adsorbed on coal and bulk water.

2. Cooper, H.M., Tarpley, E.C., Abernethy, R.F. U.S.Bur.Mines, R.I.4197, Feb.1948, 6pp.
HEATING-VALUE LOSS OF COAL ON AIR-DRYING. The standard method of employing preliminary air-drying to determine the moisture in coal has been criticized with respect to the loss of heating value from excessive air-drying. Coal exposed to air will oxidize, and the extent of this deterioration may be measured roughly by the decrease in heating value as well as by the increase in oxygen content. As a result of the criticisms, a series of tests were made on coals of several ranks to evaluate the degree of oxidation, or loss of heating value, caused by air-drying according to standard practice. The results of these tests indicate that:- 1. The percentage of heating-value loss depends on the rank and type of coal. Changes in low-volatile bituminous were not detected, whereas high-volatile bituminous and subbituminous coals were oxidized slightly, with resulting slight loss in heating value. 2. The heating-value loss due to 1 or 2 days' drying beyond the time when the air-dry loss is less than 0.1 per cent per hour is negligible. 3. There is enough evidence to indicate that the heating-value determination of low-rank coals should be made as quickly as possible after the collection of samples.

3. Dietrich, L. Berlin Thesis 1941 56 pp.
Approximate determination of the temperature of particle surfaces and centres in uniflow suspension drying of brown coal by means of furnace gases.

4. Gauger, A. W. Preprint Amer.Inst.Min.Metall.Eng. New York Meeting.1932.II.
CONDITION OF WATER IN COALS OF VARIOUS RANKS. The present method of determining the water content of coals is not exact. Water recovered from coal comes chiefly from (1) decomposition of organic molecules, (2) surface absorbed water, and (3) capillary condensed water. Peat has the properties of a hydrosol. Lignite may be looked upon as a hydrogel with a spongelike structure with ultramicroscopic capillaries of varying radii. The distribution of capillary sizes as calculated from aqueous tension studies indicates a relatively greater progressive decrease in the larger sizes than in the smaller sizes in going from peat to bituminous coal. The evidence at hand favours the acceptance of the view that water is an essential constituent of coal as mined and that drying modifies the original properties of the coal. Abnormal

thermal effects of moisture in coal are shown to be directly relate to the abnormal aqueous tensions. Further studies by more refined methods are required in order that an accurate understanding may be obtained of the condition of water in coal.

1115. Schoorl, N. Chem.Weekblad,1924,21,393-394.
NORMAL WATER CONTENT OF COAL AND COKE. A large number of samples after exposure to atmospheres of varying degrees of humidity until weights were constant were examined for water content, and the resul plotted as curves, connecting water content, and degree of humidity. These curves show no relation to composition or calorific value of fuels. Ordinary determination of moisture by heating in air at 10 105^{0} to constant weight give results higher than those obtained fro loss of weight over phosphorus pentoxide at ordinary temperature an pressure, doubtless by reason of loss of occluded gases; but this difference is generally small.

Moisture Determination

1116. ---- Brit.Std.Spec.1016,1017 1942.
METHODS FOR THE ANALYSIS AND TESTING OF COAL AND COKE. Includes methods of sampling and moisture determination. Procedure for air-drying (6-10 hours at room temperature or 1½-3 hours at 50^{0}C.) Analysis of ground sample, moisture can be determined by two method (1.) Heating in a suitably designed oven at 100-110^{0}C, air or vacuu or (2) the Dean and Stark method. See also Fuel Research Board Surv Paper No.44.

1117. ---- Brit.Std.Spec.735 1944.
BRITISH STANDARD METHODS FOR THE SAMPLING AND ANALYSIS OF COAL AND COKE FOR PERFORMANCE AND EFFICIENCY TESTS ON INDUSTRIAL PLANT.

1118. ---- Zeit.f Analyt.Chem.1932.88.40-4.
WATER ESTIMATION. Survey of recent papers dealing with methods for estimating the water content of various substances, including the Fuschbeck and Einecke method for determining water in brown coal by extraction with pure acetic acid and measuring the electrical conductivity of the resulting solution; the variation in conductivity being proportional to the amount of water; and the method of Mannhe in which coal is extracted with methanol and the hydrometric variati obtained being corrected by altering the temperature, the proportion water being calculated from the difference in temperature, the amoun of coal used and the amount of methanol.

1119. Brennstoff-Chem.1938.19.No.24.N77.
APPARATUS FOR SEMI-AUTOMATIC RAPID DETERMINATION OF MOISTURE. A com prehensive unit combining all the apparatus required for determining moisture contents rapidly. Up to 10 samples can be dried simultaneou and sources of error are reduced to a minimum. In spite of the automatic operation accuracy within 0.1 per cent. is obtained and the results can be read directly in percentages.

20. Anon. Brennstoff-Chem. 1939, 20, N. 45.
BROWN COAL MOISTURE METER. A brief illustrated description is given of apparatus for the continuous determination and recording of the moisture content of samples of brown coal.

21. Anon. Eng. Digest 1942, 3, 392-93.
AUTOMATIC ELECTRICAL APPARATUS FOR MEASURING MOISTURE OF COAL. A diagrammatic description is given of the A.E.G. moisture tester which comprises a sampling apparatus, a drying oven and a balance with electrical recording. One measurement is said to take 7½ minutes.

22. Bainbridge, J.R., Eisenklam, P., Fuel 26 150-3. Nov. 1947.
Scanlan, P.G.
MOISTURE CONTENT OF BROWN COAL BY DISTILLATION. This report records experiences in determining the moisture contents from 36% to 68% (as received).

23. Barber, E. G. Inst. of Fuel "Drying Study" Nov. 1950.
THE DETERMINATION OF MOISTURE IN COAL. Discusses the difficulty of obtaining accurate determinations. Methods are described and the necessity of accurate sampling is emphasised. J. Inst. Fuel. Nov. '50.

24. Barkley, J. F. Combustion 1941, 13, No. 6, 50-1.
DETERMINING MOISTURE CONTENT OF COAL (USED FOR BOILER FIRING). Samples were obtained by the "ash-can," "bag" and "grab" methods and the consequent moisture determinations compared. The results indicated moisture by both the ash-can and the grab sample methods to be lower than with the bag sample.

25. Belcher, R., Mott, R.A. Br. Ceram. R.A. June 1951, D.S.I.R./6018/B.
OBSERVATIONS ON THE INEFFICIENCY OF A DESICCATOR IN DETERMINING THE MOISTURE IN COAL. J. Appl. Chem. 1. 5. 204. 1951.

26. Belcher, Spooner. Fuel 23 46 1944. 26 55 1947.
Methods and apparatus for the determination of moisture by direct weighing of the water.

27. Bosic, B. and Filipović, I. Brennstoff-Chem. 1939, 20, 161-163.
DETERMINATION OF MOISTURE IN BROWN COALS. H_2O was determined in 14 brown coals by (a) the "cryohydrat method, i.e., extraction with EtOH in which the H_2O is subsequently determined from the temperature of miscibility with light petroleum and (b) distillation with benzine (b.p. 90-105°), xylol (b.p. 140°), or petroleum oil (b.p. 200-220 degrees). The results of (b) were, in general, > those of (a) and were the higher, the higher was the b.p. of the liquid used. It is concluded that the method (a) gives the physically-bound H_2O, but that the distillation methods give also varying amounts of H_2O of hydration and of constitution. (From Brit. Chem. Physiol. Abst. B. 1939, 682).

1128. Bozic, B. Brennstoff Chem. 1941, 22, 113-6

DETERMINATION OF MOISTURE IN BROWN COALS. Inaccurate results are given (a) by mixing the coal with anhydrous Na_2SO_4 and drying in vacuo over H_2SO_4 or P_2O_5 and (b) drying in a current of N_2 at 105°. Accurate results are obtained by heating 5 g of coal with 12 g of cylinder oil at 210° in a metal crucible on a sand bath until evolution of bubbles ceases. The % H_2O is calculated from the difference in weight before and after heating. The method occupies 45-60 minutes.

1129. Chamberlain, E. A. C., Waters, P. A. Fuel 30, 3-13, Jan. 1951

AIR DRYING OF COAL. Results of an investigation into moisture determination with air circulation at controlled temperature and R.H.. Considered suitable for all ranks of coal. Other methods not reliable.

1130. Dolch, M., Strube, E. Oberschl. Berg und Huttenmann, 68, 349, 1929

APPARATUS AND PROCESS FOR THE RAPID DETERMINATION OF MOISTURE IN COAL. The moisture is removed from the coal by treatment with absolute alcohol; the aqueous alcohol obtained is mixed with petroleum and the temperature of turbidity determined. This temperature rises with the water content of the alcohol; absolute alcohol gives with petroleum, at room temperature, a clear solution on warming. The behaviour of 95-99% alcohols is plotted graphically as a standard curve which can then be used for the evaluation of individual determinations.

1131. Dummett, G. A. Bull. Coke Oven Managers' Association January 1935. Coll. Guard. 1935. 151, 299

MOISTURE IN COAL. The author describes a rapid method of determining the moisture in coal. If a definite volume of an aqeous solution of a reagent of known strength is mixed with a certain weight of coal, it will become diluted with the surface moisture of the coal. If then the diluted solution is filtered off and its strength redetermined, provided the mixing between reagent and coal moisture is complete and there is no appreciable interaction, physical or chemical between the reagent and the coal, the decrease in concentration is a measure of the moisture content of the coal.

1132. Fishbeck, K., Einecke, E. Z. Elektrochem 35, 756-9 1930

A NEW METHOD OF DETERMINING THE WATER CONTENT OF SOLID FUELS SUCH A BROWN COAL. Extraction with pure acetic acid and measurement of conductivity of the extract.

1133. Hirz, H. Braunkohle 28, 101-110, 1929

RAPID ESTIMATION OF MOISTURE IN BROWN COAL. This is a report of the results of the recent competition for the best laboratory method for the rapid estimation of the water content in brown coal in the range 5 - 25 per cent. water. The prize-winning methods, their application and the results obtained, are described in detail. The best method, in the opinion of the judges, is based on the measurement of the dielectric constants of the coal, a magnitude which with brown coal varies considerably with the water content. The second-best method is based on the measurement of the water distilled from the brown coal on heating in an electric furnace, for which a special heating arrangement and other apparatus have been devised. The third-best method is the ordinary xylene method but with amyl alcohol in place of xylene. The fourth-best method consisted in treating the coal with acetic acid and estimating the water by titration with caustic soda. In the fifth-best method, the heat evolved on shaking a sample of brown coal with a known weight of sulphuric acid is measured, and the water content calculated. Each of these methods is compared with the xylene method and the relative merits were determined.

34. d'Huart, K. Feuerungstech, 1926, 14, 213-214
ESTIMATION OF THE WATER CONTENT OF COAL DURING THE DRYING OF BROWN COAL. Experiments on the water content of brown coal are described, and the results are given in tabular form. The percentage of moisture increases with the size of the particles of brown coal. The results obtained show that in making estimations of water content of coal, very careful measures must be adopted to obtain a true representative mean sample. Considerable deviations in the results obtained will be caused by not so doing.

35. Iki, S. J.Soc.Chem.Ind.Japan 32, 371, 1929
MOISTURE AND COMBINED WATER IN COAL.

36. Kodama, H. J.Chem.Soc.Japan, 1939, 60, 861-74)
INVESTIGATION OF WATER IN COAL. It is suggested that water exists in coal in a dissolved state, and varies directly with the relative humidity. The saturation values are given for Manchurian Coals. Since chemical reaction takes place in the coals above 50^0, coal should not be heated at 105-10^0 in the determination of water content.

37. Lanskaya, M. P., and Khim.Tverdogo Topliva.1937, 8, 604-611
Shub, S. K.
DISTRIBUTION OF MOISTURE IN COAL. The refractometric method of Dumanskii was used for determination of bound water. Most of the water in wetted samples of coal is in the absorbed state. In the less carbonised brown coal there is a considerable amount of free water also. The high determination of wetted coal is caused by the contraction of the coal-water system; contraction in system brown coal-water is much less because of small amounts of the bound water and also because of the presence of free water. The high adsorption ability of coal is considered as the result of development of surface during transition of C from amorphous to cryst. state.

1138. Lessing, R. 8th Intern. Congress Applied Chemistry 1928. 25, 41-90

Report of the Sub-Committee on Standardisation of Methods on Determining Water in Coals and other Fuels and in Minerals of the International Committee on Analyses.

1139. Liplavk, I. L. Zavodskaya Lab., 1946, 12, 558-8; Chem. Abstr., 1947, 41, 1825

A RAPID METHOD FOR THE DETERMINATION OF MOISTURE IN COALS BY MEANS OF HIGH-FREQUENCY CURRENTS. A high-frequency lamp generator (potential of the lamp 140-50 v., anodic current strength 100-200 ma.) and a torsion balance are required for the determination. The condenser plates (130 sq. cm.) are made of Cu gauze to facilitate the escape of vapours from the system. Place two coal samples (weight 5 g. each, ground to 1.5 mm.) in silk boxes, one of which contains a thermometer. Suspend this box, separate from the balance, between the condenser plates. Place the second box with the sample on the lever of the balance and also lower it into the condenser. Regulate the distance between the condenser plates so that the temperature does not exceed 120-30°. The drying process is completed when the weight remains constant for 0.5-1.0 minute. The moisture is determined simultaneously in both samples. The accuracy of the determination is equal to that of the distillation method. The time required for the determination does not exceed 8 minutes.

1140. Löffler, H. Chem. Zeit. 1929, 53, 411

DETERMINATION OF HYGROSCOPIC MOISTURE IN COAL. An apparatus, which is described, enables the hygroscopic moisture of coal to be determined by heating the coal in a vacuum 60-70°C.

1141. Mannheimer, L. Ind. Eng. Chem. Anal. Ed. 1929, 1, 154

DETERMINATION OF THE MOISTURE CONTENT OF COAL AND SIMILAR SUBSTANCES. A new method is described which consists in the extraction of the coal by hygroscopic liquid and the subsequent determination of the water content of this liquid. Of the liquids which have been considered methanol is the most suitable. The moisture content of the methanol is established by a density determination. This method shows a small but fairly constant higher value for the water content of the coal than that obtained by extraction by xylene. The advantages of the new method are fast working, easy cleaning of the apparatus and the possibility of working at room temperature.

1142. Naklonov, V. A. Zavodskaya Lab. 1937, 6, 187-8

AUTOMATIC DETERMINATION OF THE WATER CONTENT OF SOLID FUELS AND GASES. (The H_2O) of gases is calculated from the volume of C_2H_2 produced by passing the gas through CaC_2. The (H_2O) of solid fuels is determined by shaking a mixture of powdered fuel and CaC_2 for 40 seconds and measuring the volume of C_2H_2 evolved. From Chem. Abst. 1938. 32, 3933.

143. Niemark, M. E. Koks i Khimia 1933, 3, (8), 41-44
RAPID METHOD OF DETERMINING THE MOISTURE CONTENT OF BLENDED COALS.
50 gr. of an average specimen of the coal are weighed into a dry glass bottle of 200 cc. capacity fitted with a ground stopper. 100 cc. of an n/2 solution of sodium bicarbonate, previously titrated against n/2 sulphuric acid, is poured into the bottle. The amount of dilution is found by a second titration.

144. Padovani, C. and Sinimared, C. Atti III congresso naz. chim. pura applicata 1930, 778-781
DETERMINATION OF MOISTURE IN FUELS. Combustibles may oxidise during the determination of moisture. All coals, heated to $60-70^0$ in a current of N_2 free from O_2, evolve small quantities of CO_2. A method was developed to determine simultaneously the loss of weight of the coal by heating at 100^0 in a current of N_2 and increase in weight of a $CaCl_2$ tube. Loss of weight of the coal is greater than increase in weight of the $CaCl_2$ tube. From Chem. Abst. 10. 1931, 25, 2265.

145. Pieters, H. A. J. and Smeets, G. Het. Gas. 1933. 53. 53, 322-325
MOISTURE DETERMINATION IN LIMBURG COAL. Moisture determination in several coal samples by the xylene or the EtOH method, by direct drying at 105^0 or by predrying at 50^0 gave substantially the same results. The 105^0 drying process does not change the results of subsequent Campredon caking tests. In a number of curves and tables the hydroscopicity of dried coal of B30-B40 size is demonstrated from samples cooled in a dessicator over CaO, H_2SO_4, $CaCl_2$ and P_2O_5 in open and closed dishes. Differences of up to 0.1% are found between closed and open dishes (no difference for $(NH_4)_2\ SO_4$ under the same conditions). Over dilute H_2SO_4 with 10-100% relative humidity the hygroscopic quality of dried coal is revealed in an initial rapid H_2O absorption gradually flattening off, particularly for finely ground coal and in thin layers. One g. of 0.3 mm. coal on a 9.6 square cm. surface takes up in 10 minutes 1% moisture and 2% in 1 hour depending on the humidity. From Chem. Abst. 1933, 27, 5936.

146. Rassow, R. and Reckeler, A. Z. Angew. Chem. 1932. 45, 266-7
DOLCH'S METHOD FOR DETERMINING MOISTURE. Description of Dolch's cryohydric method for determining small quantities of water in vegetable remains.

147. Rees, O. W., Bursack, K. F. Ind. Eng. Chem. 14, 729 1942
EQUIPMENT FOR DETERMINING MOISTURE IN COAL. A combination of warming oven and balance, and weighing without removing sample. Thermostatic control for temperatures $85^0 - 175^0C$. Air circulation. Results check within A.S.T.M. tolerances, and times may be shorter. Laboratory crushing entailed, loss of moisture unless lumps were air dried before crushing. Higher temperatures of drying increased rate and also oxidation.

1148. Reusse, W. Braunkohle 1940, 39, 295-8, 306-8
USE OF THE AEG COAL MOISTURE METER FOR CONTROLLING THE MOISTURE CONTENT OF COAL FROM TUBE DRIERS. The author describes the use the AEG coal moisture meter for controlling the moisture content dried brown coal within the range 8-22%; tests with the first ty of meter, errors due to irregular grading of the coal, and its reconstruction with a range of 6-13% and a drum sieve of 4 and 1 holes. The results of measurements made with coal with known moisture content were satisfactory. (From Archiv. f. Wärmewirts. 1941, 22, 22).

1149. Simek, B. G. and Ludmila, J. Brennstoff-Chem, 1942, 23, 223-7
DETERMINATION OF WATER IN COAL BY DISTILLING WITH XYLOL, AIM AND SOURCES OF ERROR. The authors discuss the importance of and the correct procedure for determining the water content of coal by distilling with xylol. Metal apparatus used at the Prague research institute is described, which it is stated gives excellen results if the instructions are carefully followed. It is shown from a series of comparative analyses of brown and bituminous coa that xylol distilling at about 153°C is particularly suitable for this purpose. Sources of error due to the solubility of water i xylol and the effect of temperature on the correct reading of the water volume are discussed, and a theoretically correct procedure is deduced and confirmed by practical tests. The error does not exceed 1% of the total quantity of water.

1150. Simek, B. G. and Ludmila, J. Fuel Sci. Pract., 26, 132, 1947
THE DETERMINATION OF MOISTURE IN SOLID FUELS. In order to eliminate differences between the methods used for the determination of water in solid fuels, results obtained by distillation-methods with benzene, toluene and xylene-were compared with those obtained by direct determination of water by absorption in calciu chloride after drying in a stream of nitrogen. Eight typical samples of coal were used for the tests. Improvements of the apparatus for the distillation method are described and an apparatus for the direct determination of water in a stream of nitrogen is suggested. Procedures for both methods are fully described. A very good agreement of the xylene-distillation method and the new suggested direct determination by drying in a stream of nitrogen at 130°C. has been found.

1151. Schmidt, L. D. and Seymour, W. U.S. Bur. Mines, Rept. Invest. No. 3811, Apr. 1945
A RAPID METHOD FOR DETERMINING SURFACE MOISTURE IN COAL. The method is based upon the change in specific gravity of alcohol caused by the absorption of water. The test consists of the extraction of the surface water from coal with a known volume of alcohol, and determination of the change in the specific gravity o the alcohol due to absorption of this water. From the data obtained the weight of the surface moisture is calculated. There are indications that the procedure can be used for a rapid,

precise, determination of total moisture content of coal if the latter is crushed to pass a No. 60 sieve and is extracted with methyl alcohol. The higher alcohols, such as ethyl and isopropyl, are better adapted to differentiating between surface and internal moisture in coal. Undoubtedly the same procedure could be used with other solvents.

1152. Taubmann, A. Z. für Analyt. Chemie. 1928, 74, 161. Gas und Wasserfach, 1928, 71, 1226
Water may be estimated in coal, coke, peat, etc., by extracting the sample for 20 minutes with pyridine which is then allowed to react with magnesium methyl iodide. The water taken up by the pyridine reacts with the magnesium methyl iodide according to the equation:-

$$2\,CH_3MgI + H_2O = 2CH_4 + MgI_2 + MgO$$

The methane is measured and is proportional to the water present.

1153. Tausz, J. and Rumm, H. Gas und Wasserfach. 1928, 71, 417-20
A method and apparatus for determining the water content of coal or brown coal is described. The coal is distilled with tetra-chloro methane and the amount of water which distils over is weighed.

1154. Velten, O. Arch. Tech. Mess. Publ. No. 101 Bachem. bez. Koln. 1939. Chem. Zentrbl. 3, I. 814, 1940
CONTINUOUS DETERMINATION OF MOISTURE CONTENT OF BROWN COAL FOR BRIQUETTING. Application based on the principle of Dielectric constant.

1155. Vetter, F. Mikrochemie, 1932, 10, 407-8
MICROANALYTIC METHODS IN INDUSTRIAL LABORATORIES. III. Micro-apparatus for the gravimetric determination of the water in coal and other solid substances, involving distilling the moisture over into a weighed absorbent, using toluene vapour.

1156. Vondracek, R. and Mosendz, L. Brennstoff-Chem. 1931, 12, 445-6
DETERMINATION OF MOISTURE CONTENT OF COALS BY DRYING IN VACUO. Since it is known that gases are given off by coal even below 100^0 it was thought that drying in vacuum at a lower temperature might eliminate this source of error. Experiments with four coals showed that on drying in vacuo at 60^0 higher losses in weight occurred than the corresponding moisture contents determined at 105^0. This method is therefore unsuitable for determination of moisture content.

1157. de Waard, B. and van Beek, F. Chem. Weekblad. 1932, 29, 598-603
From Brit. Chem. Abst. B. 1932, p. 5
DETERMINATION OF WATER IN SOLID FUELS. The applicability of available methods to different kinds of peat, coal and coke has been critically examined. Direct determination of the H_2O removed in a current of inert gas or by distillation with e.g., xylene is satisfactory in general, but cannot be used for low-temperature coke. Extraction of the H_2O with hot absolute EtOH and determination of the miscibility of the resulting solution with petroleum gives satisfactory results with low-temperature coke, but measurement of the loss of weight on heating in dry air for 30-60 minutes at $105\text{-}110^0$ is more convenient; the particle size of the sample should be 0.3 mm.

PEAT

General Process

1158. ---- Bord na Mona. Exptl. Res. Stn.
Droicheadnua Dublin

DRYING OF PEAT. "The station has compiled a reasonably complete list of the literature on this subject since 1937 (about 300 items) and here again numerous items have been translated, including comprehensive standard works such as those by Stadniko (our Translation No. 45) and Ostwald (our translation No. 64). From 1946 we have aimed at obtaining all important publications in the original and in producing English translations of all foreign publications. This subject is so wide that anyone interested in it is recommended to communicate with the station." Copy in D.S.I.R. library.

1159. ---- Oil Engine. June 1949

Proposal to burn undried peat for an open cycle, gas turbine, the exhaust heat being used to dry the fuel and the moisture driven off being used for turbine. North of Scotland Hydro-Electricity Board.

1160. Anon. Chem. Tr. Jnl. 15 Apl. 1949, 124, 23,
Supplement

SCOTTISH PEAT DEVELOPMENT. The Scottish Reconstruction Committee proposes to develop a power plant on the peat bog to handle, say, 80,000 tons/year.

1161. ---- Torfanaya Promyshlennost 1950
No. 1 - Jan. No. 2 Feb. No. 3 Mar.
No. 4 April No. 5 May

Successful completion of the post-war 5-years Stalin plan in the peat industry. Each number deals with about a dozen subjects which have been translated and communicated to D.S.I.R. by Bord La Mona, Experimental Station Droichead Nua. Ireland, and reproduced in the "Translated Contents lists of Russian Periodicals" No. 17, September 1950. D.S.I.R.

1162. ---- F.I.A.T. Final Report 368

DRYING OF PEAT. Nomogram.

1163. Ackroyd, G. C. B.C.S.O. (N.A.) Report 712 17 Aug. 1950
U.K.S.M. Memo No. 74/50

DEWATERING OF PEAT. Ministry of Fuel and Power sent wet samples in drums to U.S.A., for investigation.

1. Bird Process. Continuous solid bowl centrifuge.
2. Scrarples Process. Conical bowl super-decanter, with horizontal scroll rotating at 3,200 r.p.m. and 2,100 gravity, 10 h.p. motor

The results shewed that the best reduction was to 76% without acid, and to 72% moisture at p.H.2 with H_2SO4, and the bulk of the solid is lost in the process. The apparatus is very expensive.

164. Baum, K. Gas Wld. Cok. Sect. 1933. 98, 70. Iron Coal Tr. Rev. 1933 126, 905

THE MOISTURE CONTENT OF COAL. A resume is given of Report 52 of the Coke Oven Committee of the Association of Mining Interests, Essen, and the Association of German Metallurgists, Dusseldorf, on the influence of the moisture content of coal on the heat requirements during carbonisation, from which it is evident that the heat consumption is not increased by the presence of moisture up to 6 per cent.

165. Bojner, G. U.S.P. 2,413,942/1947

PROCESS OF DRYING PEAT AND OTHER AQUEOUS MATERIALS. Claim 1:- An apparatus for continuously drying wet material in several stages, comprising, in combination, a container in each stage, constituting a drying chamber for the material to be dried, a rotatable tube set in each container, constituting a heating and stirring unit for the material to be dried, a furnace for producing hot gases, a flue conduit from the furnace to one end of the rotatable tube set of the last drying stage, a conduit from the opposite end of the rotatable tube set of the last drying stage to the drying chamber of the preceding drying stage, and a conduit from the drying chamber of the last drying stage to one end of the rotatable tube set of the preceding stage.

166. Carrens, C. W. and Schott, W. Kolloid Z, 65, 195-203, (1933)

UEBER DEN EINFLUSS DES TROCKNENS AUF DIE KERNGROSSEN VORTEILUNG VON TOWEN.

167. Dalton, J. Econ. Proc. Roy. Dublin Soc. 3, 409-427, 1950

THE SAMPLING OF MACHINE WON TURF FOR MOISTURE CONTENT. An analysis of the results of an investigation covering 20 consignments over a year.

168. Davis, J. H. Geol. Bull. No. 30, Florida Geol. Surv., 1946, 13, 247 pp; Chem. Abstr., 1947, 41, 3020

PEAT DEPOSITS OF FLORIDA. A general discussion of the occurrence and development of peat deposits in Florida deals with the nature, origin, kinds, and composition of peat. Florida-peat profiles show an increase in pH with depth. The data show that low-moor, saw-grass peats have an average pH of 5.96, low-moor pond-type peats 4.45, and forest peats 4.34. The C-N ratio of peats increases with depth. Chemical analyses of Fla. peats made by various agencies are tabulated with the location and nature of the deposits. Deposits of diatomaceous materials are indicated and discussed, also the geology of the peat deposits and some of the buried derivatives such as lignite and sapropelite. The relation of peat formations to past climatic conditions and the uses of Fla. peats are considered. Pollen analyses are used to indicate past climatic and geological relationships.

1169. MacDougal, D., Richards, S. H. D.S.I.R. & Fuel Res. Bd. 1948
Winning, Harvesting and Utilisation of Peat in Foreign Countries e.g. Eire, U.S.A. Extraction of Waxes is described.

1170. Dyushin, V. I. Torfyanaya Promuishlennost (Peat Industrg.), Mar. 1947. 24, No. 3, 16-19,; Chem. Zbl, 1947, I., 768
EFFECT OF WEATHER ON DRYING OF PEAT SODS. The seasonal effect of weather on peat drying was found to be greatest on the peat pulp in the vats, the loss of moisture in this case being 4.3% before settling, 1.5% after settling and .25% in the conveyors, calculated on the basis of weather coefficients and dates. 62 to 63 weather coefficients are required to reduce the original moisture content of 96/7% to 40% in the finished peat. The minimum weather coefficient for drying is .5, below this the peat will not dry.

1171. Fairweather, H. G. C. B.P. 566, 668/1945
DRYING OF PEAT AND OTHER AQUEOUS MATERIALS. A two stage dryer for granular material in which the flue gases from a furnace pass through tubes surrounded by the material in the second stage of the drying, and thence at a lowered temperature to further tubes surrounded by the material in the first stage of drying. In each stage a part of the gases is introduced in contact with the material to carry off vapours evolved on drying. The gases containing the vapours evolved from the second stage of drying are also used out of contact with the material as a drying medium in the first or preliminary stage of drying.

1172. Hausding, A. H.M.S.O. 1921
A HANDBOOK ON THE WINNING AND THE UTILISATION OF PEAT. Translated from the third German Edition by Hugh Ryan D. Sc.

1173. Heyl, E. H. B.P. 570, 849/1945
MEANS FOR RAPID DRYING OF PEAT AND THE LIKE. Means for drying peat or other materials, the means comprising a cylinder of meshed material, disposed with its axis horizontally, and resembling an elongated basket, the cylinder being covered throughout its length with asbestos cloth and having its ends closed, means for the delivery of cold or heated drying air under pressure to the cylinder, and means for the protection from the weather during the drying process of the peat or other material, which is heaped upon the cylinder.

1174. Heyl, G. B.P.574,044/1945
DRYING AND DISTILLING PEAT IN SITU. A method of heating or heating and distilling peat and other carbonaceous deposits in the earth, consisting in forcing a metal casing around a mass of the peat or other carbonaceous deposit on the site thereof, and forcing rod-shaped electric heaters into the enclosed mass and energising the heaters to dry or distil the mass.

1175. Heymann, H., Kurz, H. German P.712,641/1941 German P.715,065/1941 Chem.Abstr.38,5664,1944
ASSEMBLY FOR DEWATERING PEAT AND OTHER CAPILLARY MATERIALS.

1176. Huc et Cie. Société Bordelaise de la Tourbe Fr.Pat.884,309/1943
HYDRO-EXTACTOR FOR PEAT.

1177. Ivanov, V. I. Torf.Prom.(Peat Ind.)26,(11)14-15 1949
DRYING WATER BORNE PEAT IN INCLINED GRID FORMATION. Peat bricks are built in openwork formation for drying, setting is at 105° instead of 90°, to each other, and quicker drying is thereby promoted.

178. Kharsanov, Y. N. Torf.Prom.(Peat Industry)No.7.1-3 1947
DRYING AND STORAGE OF PEAT.

1179. Korchunov, Voronin Torfyanaya Prom.
1. 23,3 24-7 1946
2. 24,2 28-9 1947
1. Volume change was a linear function of Moisture Content.
2. Experiments on thermal and mechanical dewatering of peat.

1180. Leverin, H. A. Canada,Dept.Mines and Resources,Mines and Geology Branch,Bur.of Mines,1946, No.817,102 pp)
PEAT MOSS DEPOSITS IN CANADA. The author briefly discusses the development of the peat moss industry and production in Canada, classification, standards and specifications for commercial peat moss, its chemical and physical examination, the operation of the bogs and plants and uses of the moss. He describes the various bogs in Canada at length.

181. Lukin, A. V. Torf.Prom.No.12,17-19,1947
RELATIONS BETWEEN MOISTURE CONTENT AND INTENSITY OF DRYING OF PEAT.

182. Luikov, A. V. Ind.Eng.Chem.27,(4)406-9,1935
THE DRYING OF PEAT. Shrinkage on Drying. Characteristics of drying Process. Experimental data. Curves of rate and temperature of drying.
1st Constant rate Period.
2nd Period varies as the moisture content.
3rd Period varies as the temperature.

1183. Lüthje, H., Steinert, J. B.P.525,924/1940

IMPROVED PROCESS AND APPARATUS FOR DRYING PEAT AND SIMILAR SUBSTANCES FOR THE PURPOSE OF RAISING THE HEATING VALUE. A process for treating peat or wood with super-heated steam circulating between super-heater and material, characterised by the feature that by raising the steam temperature up to 180°C. without pressure increase the peat or wood is converted by decomposition of oxygen-containing constituents into a coal product of higher heatin value than the peat or wood dry substance.

1184. Lyman, G. Swed.P.108,066/1941; Chem.Zentr.1944, II, 390

PRODUCTION OF PEAT. Peat is obtained in the usual way and formed into bands or slabs. These are first laid between paper or the like till they have become sufficiently firm. Only then is the further drying carried out in the usual manner. In this way the drying time is also shortened.

1185. Malm, L. Jornkontorets Ann., 1945, 129, No. 3, 123-61
Engrs.Dig., Apr. 1946, 7, 97-100)

PRODUCTION OF ELECTRIC POWER FROM PEAT. The chemical composition and combustion characteristics of peat are discussed and the influence of water content on the latter noted. The rapid decrease in effective C.V. of peat with increasing moisture necessitates predrying for efficient combustion. This drying is also necessary to reduce stack losses. A typical steam circuit of a plant in which peat is dried by low pressure steam is described, consisting of a back-pressure and a condensing turbine, steam dryer and feed-water heaters, and formulae for the amount of peat per Kw. hr. derived. A description of a power station based on utilizing peat of 70% moisture content is given, and drying by means of flue gas also noted.

1186. Martin, J. J.Instn.Civ.Engrs.Ireland, 197 pp. 1945-46

THE WINNING AND UTILISATION OF MILLED PEAT.

1187. Martin, J. Jnl.Inst.of Fuel, 23, (131) 137-143 May 1950

SOME CONSIDERATIONS ON THE WINNING AND UTILISATION OF PEAT. The various methods of production are described. Handwon, Machine-won, Milled Peat, Peat Briquettes (stacked and loose). Considerable investigation in artificial drying, chemical, electrical, bacteriological, thermal and mechanical, have been tried with little or no success. The Germans have been able to compress from 90% moisture to 65% moisture. At this point, thermal drying becomes economical, and the peat is further dried to 10-15% m. for briquetting. Detailed costs are given.

1188. Tadeusz, Mielocki
MOISTURE DETERMINATION. See under "Coal"

1189. Miller, H. M. S. J.Institute of Fuel, 24, 136, 49-5, March 1951
DRYING OF PEAT. Although peat needs no mining, the difficulties of water-removal hinder its industrial utilisation. Methods of drying are described and the influence of physical properties related thereto.

1190. Combustibles, F. E. Menu Fr.P. 892,173/1944; Chim. et Industr., Dec. 1945, 54, 410
APPARATUS FOR DRYING WET PEAT BRIQUETTES OR THE LIKE. Pre-drying is effected to cause a very rapid reduction of moisture, to prevent the briquettes from sticking together and to impart to them a consistency such that they can be handled in the final drying without distortion. Pre-drying can be effected on a number of endless belts on which the briquettes pass through a heated chamber; the final dryer has a device permitting entry of hot air in counter current to the direction of travel, the air rising among the briquettes which move downwards. The briquettes have a high density and a certain porosity which confers upon them a high degree of reactivity. On carbonisation they produce a very solid reactive coke.

1191. Ostwald, W. Kolloid Z. 29, 316-329, 1921
THE COLLOID CHEMISTRY OF PEAT. (1) The nature of the water combination in peat.

1192. Oyvin, N. L. et al
RESULTS OF TESTS ON DRYING OF COAL AND PEAT IN SUSPENDED CONDITION. See under Coal.

1193. Petrenko, F. F. Torfyanaya Promyshlennost (Peat Industry), 1947, No. 9, 5-9
MECHANIZED DRYING AND CUTTING OF BOG PEAT. Deals with large-scale draining of peat bogs and cutting of the dried peat in situ. Diagrams showing the method of procedure are given.

1194. Pilo, C. W. Swed.P. 118,635/1947 and Suppl. Swed.P. 114,575; abstr. in Chim et Industr., May 1948, 59, 455
PROCESS FOR DRYING AND CARBONIZING PEAT. Flue gas from the superheater is mixed with the air used previously for drying, in the upper part of the chamber.

1195. Pilo, C. W. B.P.587,890/1947
CONTINUOUS DRYING OF MATERIAL IN SOLID FORM AND HALF-CARBONIZING OR CARBONIZING OF PEAT AND OTHER CARBONACEOUS PIECE MATERIAL. The raw material to be converted is fed from above into a shaft and permitted to sink continuously, in a coherent column, through the shaft while there is admitted a hot gas current, of which at least a considerable part consists of heated air. The material being contacted as it sinks in the shaft through an after-drying zone located below the pre-drying zone with a counter-current of a second hot gas consisting substantially of superheated water vapour at least part of the second gas current, after having absorbed water from the material, being withdrawn from the shaft at the top of the after-drying zone and after having at least in part, passed a superheater located outside the shaft, being recirculated into the shaft below the after-drying zone, a valuable fuel product being withdrawn from the bottom of the shaft.

1196. Prokhorov, N. J. Torfyanaya Prom. 24, (2) 10-13, 1947
Chem. Abstr. 41, 4907, 1947
BRIQUETTING PEAT.

1197. Racheyev, M. P. and Isvest. Bcec. Teplotech. Inst. 76, 713-22
Vinogradoxy, K. A. 1932
PNEUMATIC DRYING OF CUT PEAT. Tests on equipment and process for pneumatic transportation of cut peat and drying with hot gas-air mixtures.

1198. Rossi, V. Tekn. Tidsskr. 79, 873-5 Nov. 1949 Chim. et
Industr. 63, 519, May 1950
NEW IDEAS ON DRYING PEAT.

1199. Shildkrot, M. M. Za Ekonomiyu Topliva (Fuel Econ.),
Nov. 1947, (11), 26-31
COAL-AND MILLED-PEAT-FIRED FURNACES. Gives diagrams, tables and graphs showing results of tests with coal- and milled-peat-firing.

1200. Simkin, M. E., Cherkinskii, B. M. Textilnaya Prom. No. 2. p. 37
FURNACES OF A NEW TYPE FOR BURNING PEAT.

1201. Smirnov, V. D. Torfyanaya Promyshlennost, 1947, No. 10,
20-22
PEAT PUMPS. Describes a small pump model for pumping peat of 91% moisture content.

1202. Soper, H. R. Internat. Industr. 25, 347-9 381-3, 1944
WINNING AND DRYING OF INDUSTRIAL PEAT.

1203. Stepanov, N. P. Torfyanaya Prom. (Peat Industry) No. 7
6-10 1947

RECORDING WEATHER CONDITIONS IN PEAT DRYING.

1204. Tsuprov, S. A. Torfyanaya Prom., 1947, 24, No. 2, 30-7;
Chem. Abstr., 1947, 41, 4907

MECHANICAL DEWATERING OF PEAT. Mechanical dewatering of peat as worked out at the Moscow Peat Institute is described.

1205. Varga S. Hungarian Patent 138,399 1948. Chem.
Abstr. 43, (1951) 1949

IMPROVEMENT OF PEAT. Sun dried peat is further dried by hot air at 90-100^{0} and then subjected to reduced pressure. Superheated tar or oil vapours, (from mazut, coal, etc.) are introduced into the container to remove the hygroscopicity of peat and increase its fuel value.

ressure Drying

1206. Sec. Dept. of Agric. for Madruck G.m.b.H. Staltach/Obb.
Scotland Peat Div. Edinburgh Jan. 1950

A band press has been working 24 hours a day since July 1949 at Shussenried without any mechanical breakdown.

207. Chambert, B. and Béquer, A. Ann. Mines, 136, (1), 32; Coke,
May 1947, 9, 151

NEW DEWATERING PROCESS FOR MANUFACTURE OF PEAT BRIQUETTES. This paper refers to possibilities of utilising peat in gas producers and in carbonisation processes, but is mainly concerned with the drying of raw peat, as a preliminary to briquetting or other processing, by coating fragments of the wet material with dry peat dust, which provides innumerable capillary passages for the drainage of water when the material is passed through a special band press. It is claimed that this method overcomes the difficulty otherwise experienced from the formation of what is virtually a colloidal compound of the particles of peat with water.

A detailed analysis of the process as used at Schussenried, is given in the original paper, with a full statement of the heat balance. The briquettes, made in different shapes for domestic or industrial use, have a calorific value of from 4,400 to 4,500 calories per kg (7,920 to 8,100 B.Th.U. per lb.). Reference is made to the possibility of utilising the prepared fuel in gas producers. The briquettes as normally produced do not withstand steaming, but tests indicate that they are considerably improved in this respect if the prepared peat is heated to from 80^{0} to 90^{0}C. (176^{0} to 194^{0}F. immediately before entering the press. Other tests, based on heating the peat in an autoclave, indicate that the material is completely disintegrated by the explosive action of steam generated in its capillaries, and that briquettes made from such peat are strong and yield excellent coke.

1208. Hinchley, J. W. Ind. Chemist. 5, 32, Jan. 1929 Conf. on Drying, Inst. of Chem. Engrs.

DRYING BY PRESSURE. Use of heat not likely to be successful, but peat can be pressure dried to 80% M. in the cold. With a special press and steam, the mucilaginous character can be destroyed and three-quarters of the water (originally 85-90%) can be removed at 400 lbs. pressure.

1209. King, D. S. B.P. 637, 168, 1950

DEWATERING AND DRYING OF PEAT. Apparatus comprises an extruder having a fish tail delivery nozzle and a pair of rollers to receive and squeeze the extruded product.

1210. McLeod, H. N. B.P. 572, 907/1945

DRYING APPARATUS OR DEHYDRATING PLANT FOR THE TREATMENT OF GRASS, PEAT AND OTHER MOIST SUBSTANCES. Drying apparatus for dehydrating plant comprising in combination a comminutor for commutinuing or dividing up the material collected by or fed into the apparatus endless conveyor means adapted for taking a grip on the material received from the comminutor, pressing means active upon the conveyor means at one point in its travel to compress the material and wring moisture therefrom, heated drums supporting the conveyor means over a part of its further travel, a heating and drying chamber receiving the material after its delivery from the conveyo means and a source of heat or heat economizer means adapted for supplying heated air or hot gases and vapours to the units requiri heat supply.

1211. Petroff, P. C. Belg. P. 447, 404/1942; Chem. Abstr. 1945, 39 1039

DRYING PEAT AND OTHER COLLOIDAL GELS. The peat is pressed between jute cloths under a pressure of 50 kg. per sq. cm., and then kneaded with partial addition of water and eventually with a peptizing agent. It is then shaped into a coherent form (e.g. in a slubber), dried rapidly and carbonized to yield a hard coke suitable for use in gas producers for automotive engines.

1212. Voromin, N. A. Torfyanaya Prom., 1947, 24, No. 2, 28-9; Chem. Abstr. 1947, 41, 4907

THERMO-MECHANICAL DEWATERING OF PEAT. The H_2O content of cut pea is reduced to 72.5%. Next the peat is treated for 20 minutes in horizontal autoclaves with steam at 185^0. This step is carried out with the peat placed in layers 20 cm. thick on multi-shelved (metal) rotating cars. From this treatment the peat is hydraulically pressed at 100 kg. per sq. cm. to 37% H_2O. The steam-gas mixture leaving the autoclave contains 0.5-0.9% of furfu and is utilized for the production of furfural. The liquid expressed in the presses contains 2.5% of reduced substances of wh 40% are fermentable. This liquid is utilized for the production EtOH.

1213. Widell, T. (I.V.A.)Tidskrift för Tekniskvetenskaplig Forskning ed. Ingeniörsvetenskapakademién, Stockholm, 14, 343-357, 1945

(a) Humidity balance of peat.
(b) Pressing of peat after mechanical and thermal treatment.

1214. Widell, T. Iva, 1947, 18, (5), 149-156; abstr. in Chim. ét Industr., June 1948, 59, (6), 561

REMOVAL OF WATER FROM PEAT BY PRESSURE. Laboratory experiments and tests on a semi-industrial scale with a continuous press specially designed for the purpose have shown that it is possible to lower the humidity of relatively slightly moist peats in thin layers to 60-65% by pressure. Among the numerous chemical, mechanical and thermal pretreatments proposed, only carbonisation of the wet peat has given positive results of practical value.

dditives

1215. Goryachkin, V. G., Sidyakin, S. A. Torfyanaya Prom. 25, (6). 10-15 1948 Chem. Abstr. 44, 819, 1950

COAGULATION OF HYDROUS PEAT WITH FERRIC CHLORIDE. An increase in the coefficience of filtration and improved drainage in the field of drying of hydrous peat accompanies the use of Ferric Chloride as a coagulant when peat is prepared for subsequent mechanical dehydration.

216. Richards, S. H. Nat. Res. Council Sussex St. Ottawa, 1948. U.K.S.M. Memo. No. 14/1949, D.S.I.R. 2657

PEAT DRYING WITH ADDED CHEMICALS. Addition of alkali compounds and FeS04 (in solution) during the maceration of wet peat increased the rate of drying and shrinkage and density of the air dried block (extruded) after 15 minutes mixing. Neutral salts had little effect.
FeS04-10 lbs. per ton dry peat.
Soda ash or NH_4OH - 20 lb. per ton dry peat increased density from about 0.6 to 1.01. Lime had little such effect. Air drying without heat reduced moisture to 10% during Summer months.

217. Giovann del Zotto Ital. Pat. 431,384 27.2.1948

DRYING PEAT. Peat blocks are treated with 10% H_2SO4 (dil. 1 : 10), subjected to A.C. at 125 volts for 30 seconds and pressed; 65% of the water is removed.

Electro-endosmosis

1218. ---- Emergency Sci. Res. Bureau, Eire Report for 1941/45 Dublin.

DRYING OF PEAT BY ELECTRICAL ENDOSMOSIS. Observations indicated that the method could not be expected to be developed sufficiently quickly and on the extremely large scale of the fuel demand.

1219. ---- The Engineer 8 Apr. 1949 187, 4863 p. 381

See under "Electro-endosmosis. Sect. 2.

1220. Aspegren, O. E. A. Swed. P. No. 120,713/1948; abstr. in Chim. et Industr., 1948, 60, (4), 348

PROCESS FOR DEHYDRATION OF PEAT AND OTHER ANALOGOUS MATERIALS CONTAINING WATER WITH HELP OF ELECTRIC CURRENT. The liquid passes with the current from a positive towards a negative electrode. The product containing little water obtained during the dehydration is eliminated at the positive electrode, before its water content falls to the point at which its galvanic resistance is sensibly increased.

1221. Hinchley, J. W. Trans. Inst. Chem. Eng. 6, p. 128-130 Conf. 6/12/1928

DRYING BY PRESSURE. Pressing reduced M. from 90% to 80%; but after steaming, 400 lbs. pressure removed ¾ of the water. Apparatus described. The amount of energy required for steaming is 50 times that for pressing. Electro-osmosis disputed as being successful. Germany quoted as having successful process. Voltages quoted as 600-200 volts.

1222. Nermst, W.

THE DRYING POWER OF GALVANIC ENDOSMOSIS. Peat as an example. See under "Electro-endosmosis". Sect. 2.

Freezing

1223. Forsyth, W. G. C., Fraser, G. K. Nature, 1947, 160, 607

HUMUS: FREEZE DRYING AND PURIFICATION. It has been found that, if the precipitates of soil organic matter are frozen solid in the presence of electrolytes to a temperature of at least - 3°C. and then allowed to thaw, the colloidal properties are destroyed and the solid and aqueous phases separate. The materials lose not only their water-holding capacity, but also their general adsorptiv power, and therefore soluble contaminants are readily removed by washing with water. The method by which a considerable degree of purification is attained, is applicable to materials such as alkali-lignin precipitated from the waste liquors in the soda proce

1224. Vloeberghs, A. Belg. P. 44,723/1942; Chem. Abst. 1945, 39, 60

DEHYDRATING PEAT, LIGNITE AND THE LIKE. The material is subjected successively to a temperature below and then higher than the f.p. of the water contained therein, so that a large portion of the water is instantly liberated.

cess and equipment

5. ---- T.A.P.P.I.1946
BIBLIOGRAPHY OF PAPER MAKING 1936-1945. Drying Section pp.296-306, about 160 refs.

6. ---- Sci.Libr.Bibl.Series No.523.1929-1939
BOOKS ON PAPER MAKING. 43 Refs.

7. C. J. West Lockwood Trade Journal Co.N.Y.1929.
016.676
BIBLIOGRAPHY OF PAPERMAKING.

8. ----
DIPPERS VS. SYPHONS.
Pulp and Paper Mag. Canada. 12 606.1915
Papier 31 85-87. 1928.
Wochbl. Papier fabr. 51. 21. 1492. 192

9. Anon. Paper Trade Jl., 91, No.18, Oct.30, 1930,
pp.171-173, 1
FORCED VAPOR CIRCULATION IN PAPER DRIERS. Factors affecting heat transfer, proper drainage of each drier, elimination of air and water, ideal conditions in driers, wet end section, uniform and efficient operation at wet end, indestructible outside float control, improved double bar type and flexibility and simplicity.

0. ---- Papier-Fabrikant.29(1931)P.705
DRYING OF PAPER AND FELTS.

1. Anon. Wochbl.f.Papier fabr.66.46.818.1934
HIGH PERFORMANCE CYLINDER DRYING. Details of cylinder construction.

2. ---- T.A.P.P.I.17.210.1934.Paper Tr.Jnl.103
(3)26.1936
QUESTIONNAIRES CONCERNING PERFORMANCE DATA IN A NUMBER OF PAPER MILLS.

3. Anon. Pappers-och Travarutidskrift for Finland
(Finnish Paper & Timber J) Apr.1935
(Special Issue)P.262-3
FINE SPECIMEN OF FINNISH ENGINEERING. What is claimed to be biggest pulp-drying machine of world, installed at Kymmene Aktiebolag in Finland; designed for bleached sulphite and equipped with Minton vacuum drier, electric sectional drive and Jagenberg precision cutter. (In English.)

1234. ---- Mc.Graw-Hill.London.5 1939.3rd Edit.
MANUFACTURE OF PAPER. Joint Text Book Committee of the Pulp and Paper Industry of the U.S. and Canada.

1235. Anon. Paper Makers' Association of Great Britain and Ireland.(Pamphlet No.1, London,1945)
FUEL ECONOMY; factors affecting the drying of machine-made papers

1236. ---- Amer.Hydrotherm Co.118.387.I.R.W.1948
HEATING AND COOLING OF CALENDERS AND PLATEN PRESSES. H. Temp. fluid system. Water up to 400°F. and chemicals for higher temps. Heat transfer at a much greater rate.

1237. Anon. Engineer page 487,189.4917.21/4/50
A DRYER FOR MACHINE GLAZING CYLINDERS. The humidified paper is glazed on one large roll instead of a number of small ones. The water is squeezed out on the roll under considerable pressure and dried by a current of hot air, above boiling point, in a hood. Originally paper 57% and water 43%. Increased rate of output, fr 1,420 lb. to 1,900lb. per hour. The drying air is recirculated b way of an upper heating chamber. 2 illustrations of the Spooner dryer.

1238. Anon. Ind.Heating Engr.13.67. 142-145.1951
VENTILATING IN A MODERN PAPER MILL. A description of the special plant installed at Glory Mills, High Wycombe for maintaining clean controlled atmospheric conditions. Describes the condensation fr ceiling, hot air apparatus between rolls etc. Illustrations.

1239. ---- Fritz Publ.Inc.Chicago.1950-51
PAPER AND PULP MILL CATALOGUE. Engineering Handbook. 524 pp.

1240. ---- B.I.O.S.Report 452 p.1 and cover
1. Kranz hot air dryer for drying of cheeses, illustr.
2. Haas warmluft trochner for pulp in endless sheets. Illustr. and an advertising description without any data. Non-contac dryer. Drying machines for all industries.

1241. ---- B.I.O.S.Report 1041.168 pages.
GERMAN PAPER MAKING INDUSTRY. Description and Drawings.

1242. Adams, F. W. Paper Trade Jl., 92.No.8, Feb.19, 1931. pp.118-120
STEAM CONSUMPTION IN THE DRYING OF PAPER. Gross heat requirement table of heat requirements and steam consumption of various hypothe tical machine rooms; paper machine operating factors. Before Tech. Assn. Pulp and Paper Industry.

243. Adams, F. W. Paper Tr.Jnl.98(1)4 Jan.1934.p.38-40
RATE OF DRYING OF NEWS PRINT.

244. Adams, F. W. Paper Tr.Jnl.102.25.51-2.18 June 1936
THE RATE OF DRYING OF WRITING PAPERS. The results of a questionnaire survey are presented. Rates increase with steam temp., but are lower than for other grades of paper and board.

245. Adams, F. W., and Cooper, C. M. Ind.Eng.Chem.22.127-32.1930.Trans.Am. Inst.Chem.Engrs.1929
ECONOMISERS IN THE DRYING OF PULP AND PAPER. Results of 6 tests.

246. Adams, F. W. and Montgomery, A. E. Paper Tr.J.103.3.26-7.16 July 1936
EVALUATION OF DRYER PERFORMANCE. Results of a questionnaire survey reveal the wide variation in production and evaporation rate existing in the industry. Graphical illustrations of dryer performances.

247. Adkins, L. R. Paper Tr. Jnl.132.20.21-22.May 18 1951
THE YANKEE MACHINE FOR DRY OR SEMI-CRAPED TISSUE. A description of the Yankee dryer and its advantages. Application to a craped tissue.

248. Asten, E. von Paper Mill 546-22,1931
PAPER DRYING.

249. Baker, R. R. Paper Trade J.,1947,125,T.A.P.P.I.9-12
PAPER MACHINE: HEAT BALANCE AND DRIVE. Two important costs must be taken into consideration in the operation of the paper machine: the power costs for driving the machine and the steam costs for drying the paper produced on the machine. Through the proper selection of prime-movers, steam pressures and temperatures, it is possible to obtain a substantial part of the plant power requirements as a bye-product of the drying steam. In selecting a suitable drive for the paper machine the question of heat balance must be considered. Although essentially the power requirements vary directly with the operating speed of the machine, the machine production rate and consequently the drying steam requirements remain constant over the speed range. There are three types of drive applied to the modern paper machine, including the adjustable speed turbine line-shaft drive, the single motor line shaft drive, and the sectional electric drive. The operating efficiency of each type is discussed with reference to the over-all heat balance of the plant.

1250. Banta, H. D. Paper Industry 16 No.8 Nov.1934 p.566-
YANKEE MACHINE. Details and diagrammatic sketch of machine with fourdrinier wet end; some of expedients resorted to in order to increase production with this type of machine.

1251. Brookover, R. S. Paper Industry 32.964-5.9 Dec.1950
NEW EQUIPMENT IMPROVES OPERATIONS AT PHILA. BOARD MILL. Describe
the continuous condensate arrangements of the new installation of the Crown Paper Board Company.

1252. Brown, C. O. Ind.Eng.Chem.41(3)94A.March 1949
EQUIPMENT AND DESIGN. VACUUM SHELL. Operator weaves a sheet of wet pulp over and under 100 or more spinning heated rolls by directing a stream of air on to the sheet from outside the high vacuum shell enclosing the entire machine.

1253. Clapperton, Henderson Blackwell 3rd.Edition 1947
MODERN PAPER MAKING.

1254. Clark, F. C. Paper Trade Jl.101 No.19 Nov.7 1935
FACTORS OF IMPORTANCE. p.33-35

1255. Clegg, R. R. Inst. of Fuel. Drying Study March 1951
DRYING IN THE TEXTILE, PAPER AND ALLIED INDUSTRIES. See under Textiles.

1256. Cleveland Paper Ind. and Paper World.30.251-2.194
B.II.470.Oct.1948
CONDENSATE RETURN SYSTEM INCREASES PRODUCTION. The installation of a closed high pressure return system led to an increase of 17½% production in 2 cylinder machines. The turbulent steam flow eliminates air and condensate from the dryer, resulting in a uniformly high steam temperature within the dryer and a higher heat transfer rate through the dryer shells. Time to heat the dryers at start was reduced from 2-3 hours to 10-15 mins.

1257. Cooper, E. W. G. Paper Trade Jl., 92, No.8, Feb.19, 1931, pp.110-112
THE EFFICIENT DRYING OF PAPER. Important factors in efficient drying of paper; fuel values; radiation losses; stock temperatures; presses and driers; siphons. Before Tech. Assn. Pulp and Paper Industry.

1258. Cross, C. F. and Bevan, E. J. Spon.London 5th Edit.1920
TEXT BOOK OF PAPER MAKING.

1259. Duchaillut, J. Papeterie 54, 182,185-6,189-90M(1932)
MODERN DRYERS FOR CARDBOARDS AND PAPERS. Modern hot air driers secure more even drying of the paper with incr. eff. Rel. merits and uses of festoon and horiz. sole dryers discussed. Improved struct., heat and better air circ. are impt. features of modern dryers of hot air types.

1260. Ehrisman, H. O. Paper Trade Jnl. 103 No. 1 July 2 1936 p. 93-6
NECESSITY OF MOISTURE CONTROL ON PAPER MACHINES. Difficulties arising from improper sheet moisture experienced on paper machine reference to recent test data; press-room conditions; proper moisture content; brief comment on Foxboro Verigraph moisture control. Bibliography. Before Am. Pulp and Paper Mill Superintendents Assn.

1261. Emerton, H. W. British Paper and Board Industry R.A. T/10 Apr. 1950. 44pp.
SOME METHODS OF MEASURING MOISTURE IN PAPER. A survey of the various moisture detn, methods, bibliography and suggestions for further investigations. More detailed descriptions of electrical and electronic methods as applicable to paper. Calculations are given relating the sensitivity of these methods to the thickness of the paper.

1262. Flyate Bumazhnaya Prom. 16(2)p. 14. 1937
CONDITIONS IN DRYING PROCESSES.

1263. Goldsmith, W. F. TAPPI Series VII. p. 161 1924
DRYING OF PAPER.

1264. Gough, J. B. and Hill, H. S. Paper Trade Jnl. 103.7.98-104. 13 Aug. 1936
THE MENTON VACUUM DRYER IN THE NEWSPRINT INDUSTRY.
1. Description of operating conditions, and thermal efficiency. (The latter in favour of vacuum drying.)
2. The quality of vacuum dried paper. (Improvements in softness, absorbency and smoothness.) 6 Refs. on the vacuum drying of paper.

1265. Cram, H. G. Paper Trade Jnl. 101 No. 17 Oct. 24. 1935 p. 36-9
EFFECT OF DRIER DRAINAGE UPON DRYING OF PAPER AND ITS CONTROL. Experience at plant of Maine Seaboard Paper Co., Bucksport; power required; steam economy; rate of heat transfer; effect of drier drainage upon regulation of steam flow to driers and moisture content in sheet; requirements of condensate section; Cram system; balanced differential feature. Before Tech. Assn. Pulp and Paper Industry.

1266. Gschwind, J. F. T.A.P.P.I.34.167-171.April 1951
CONTINUOUS DRYING OF PULP BY CONVECTED AIR.

1267. Isnard, R. Paper 26,217-224(Feb.'23)Paper Ind.5 No.
1233,Nov.23 T.S.77,56.
CONTRIBUTION TO THE STUDY OF DRYING.

1268. Kaiser, F. Z.Bayer,Revisions-ver.34,No.17 et.seq.
(1930)
CHARACTERISTICS OF PAPER MACHINES WITH SATURATED AND SUPERHEATED STEAM.

1269. Kaiser, F. Wochbl.f.Papierfabr.62.19.450-454.1931
THE PERFORMANCE OF PAPER MACHINES WITH SATURATED AND WITH SUPERHEATE
STEAM. Experimental investigation.

1270. Kehoe, R. D. Paper Trade J 104 No.24 June 17 1937 p.
34,36 and 39
LATER MILL PRACTICE IN DEWATERING AND DRYING OF PULPS. Progress and equipment in drying and pressing pulp; chart showing difference in water contents of pulp of different tests by pounds and percentages.

1271. W. Clowes & Sons
London
Tech.Sect.of the Br.Paper and Board
Makers Association (Inc.) 1949
PAPER MAKING. A general account of its history, processes and application. 208 p.p.

1272. Kienzl, H. Papier-Fabrikant,vol.29,No.20,May 17,19
pp.310-313,5 figs.
PULP DEWATERING BY MEANS OF SUCTION CELL FILTERS WITH SPECIAL REGAR
TO NEBRICH SUCTION FILTER. Different types of suction filters are described, with special reference to filter by firm of Nebrich in Koethen, Germany, divided in cells.

1273. Lassberg, von Papier-Fabrikant,vol.29,No.17,Apr.26,19
pp.259-263
DRYING OF PULP AND PAPER. Discussion of processes and equipment.

1274. Lassberg, von Chem.App.18.196(1931)Nov.10
DRYING OF CELLULOSE AND PAPER. Review of recent practice (up to Dec.1930).

275. Liecester, G. H. Pap.Tr.Jnl.25 Sept.1924.79.No.13,43-4
DRYING PAPER. Drying efficiencies at various moisture contents at entry to rolls. Restricted efficiencies, c.f. overall efficiencies, depends upon the steam used for room air heating and disposition of ventilators. The effect of oil in the drums, and the advantages of oil separators where exhaust steam is used.

276. Lütschen, E. Chem.App.18,197(1931)
REMOVAL OF AIR AND WATER FROM THE DRYING END OF PAPER MACHINES.

277. Luetschen, E. Papier-Fabrikant,29,No.20,May 17,1931, pp.305-310,6 figs.
DRYING SECTION OF PAPER AND CELLULOSE MACHINES. Conditions governing efficiency of drying section and means of obtaining highest output with lowest pressures and temperatures.

278. Luetschen, E. Papier-Fabrikant,29,No.21,May 24,1931, pp.325-326
DRYING WITH SUPERHEATED STEAM. Conditions under which superheated steam may be used for drying paper are summarized, but author, on basis of his experience, does not consider general use of superheated steam advantageous.

279. McBain, B. T. Paper Mill,54,No.8,Feb.21,1931,pp.52,54 and 60
SUCTION ROLLS. Advantages of suction rolls for paper and pulp drying machines for couch and presses; vacuum forming paper machine. Before Tech. Assn. Pulp and Paper Industry.

280. McBain, B. T. Paper Trade Jnl. 92,No.12.Mar.19,1931, pp.62-63
SUCTION COUCH AND PRESS ROLLS. Before Tech. Assn. Pulp and Paper Industry, previously indexed from Paper Mill, Feb. 21, 1931.

281. McKee, R. H. and Shotwell, J. G. Paper Trade J.97.33-42(1933)
A New Process for the Moisture Control of Paper.

282. MacNaughton, W. G. Paper Tr.Jnl.117.7.30-37.12 Aug.1943
DRYING RATES OF NEWSPRINT-1942. The data presented cover the operation of 40 paper machines in 17 mills. The speeds of the mcs. range from 703 to 1400 f.p.m. The factors influencing the steam temp., are discussed and a plea is made for tests at regular intervals and of surface temps. of the dryers. The study is made from the point of view of the effect of evaporation on the steam temp., rather than the reverse.

1283. Masters, H. R. Paper Industry 16 No. 3. June 1934. p. 184-
INDIVIDUAL VS. GROUP DRAINAGE OF PAPER MACHINE DRYERS. Systems n
in use; requirements for perfect drainage; drainator constructio
and operation; air handling capacity of drainator; diagrams give

1284. Miller, J. H. Paper Ind. & Paper World 29.973-5. 1947
B. II. 309. Aug. 1948
AIR DRYING OF FINE PAPERS, by the loft, festoon, spar, and roll or tension type of drier. Modern form of roll drier, elect. drive, tension control, recirculation of air. Moisture recorder at end of air drier for automatic control.

1285. Milnes, A. Paper Tr. Jnl. 21 July 1949. 129. No. 3.
pp. 37-41
THE EFFECT OF CONDENSATE AND AIR ON OUTPUT, QUALITY AND STEAM CONSUMPTION OF PAPER MACHINE DRYERS. A description with diagrams of the above effects and of arrangements, drainage traps, and air vents, designed to mitigate the effects. Advocates individual ro
control by means of efficient drainage traps and air vents.

1286. Minton, O. T.A.P.P.I. Series VII, 1(1924)
MINTON VACUUM PAPER MACHINE DRYER. DESCRIPTION.

1287. Minton, O. Paper Tr. Jnl. 106.7.30-34. 17 Feb. 1938
DRYERS IN THE PAPER INDUSTRY. Deals with the main types of dryin
equipment, incl. vacuum equipment; and with a comparison between them. Emphasis is laid on the advantages of the vacuum dryer.

1288. Montgomery, A. E. Paper Trade Jnl. vol. 92, no. 4. Jan. 22, 193
pp. 47-49, 1 fig.
SOME IDEAS ON THE DRYING OF PAPER. Obtaining strength in sheet; Briner and Guild experiments; economy of drying; vapor removal; multiple effect or multi-stage evaporation; multi-stage paper drier. Paper presented before Pulp and Paper Industry.

1289. Montgomery, A. E. Paper Mill, vol. 8, no. 41, Oct. 11, 1930,
pp. 14, 16 and 23
THE ROSS-GREWIN SYSTEM. System consists essentially of apparatus and distributing piping for blowing heated air at high pressure and high velocity through nozzles of small diameter located in alterna
vapor pockets on both front and rear of paper machine. Paper presented before Am. Pulp and Paper Mill Superintendents Assn., Oct. 3, 1930.

1290. Montgomery, A. E. Paper Trade J.96,No.11,32-5(1933) March 16

DRYING RATE FOR KRAFT PAPER. A statistical study of U.S. kraft mills shows that the no. of lbs. of water evaporated per sq. ft. drying surface varies linearly with steam temp., as expected (air tem. being more or less const.) but the rate is relatively independent of thickness of sheet of freeness of stock and decreases only slightly with increasing length of machine though individual plants report rates varying from 1.0 to 3.0 (corrected to 250°F. steam temp.).

291. Montgomery, A. E. Paper Trade J v 102 n 8 Feb.20 1936 p.116,118 and 120

DRYING RATE FOR TISSUE AND ABSORBENT PAPERS. What constitutes good, fair and poor practice of drying rates; definition of and method of calculating drying rate; general conclusions. Bibliography. Before Tech. Assn. Pulp and Paper Industry.

292. Montgomery, A. E. Paper Tr.J.104.22.30-1.3 June 1937

THE INFLUENCE OF AIR ON DRYING. Factors determining the effectiveness of air, influence on evenness of drying and on rate and steam economy.

293. Montgomery, A. E. Paper Tr.J.108.8.107-8.23 Feb.1939

DRYING RATE FOR BOOK AND OTHER PAPERS. The results of a questionnaire survey shew that the drying rates for book and printing papers are lower than for newsprint, but higher than for other classes.

294. Montgomery, A. E. Paper Tr.J.108.11.44-47.16 Mar.1939

DRYING RATES FOR PAPER BOARD. On the results of a questionnaire survey, production and evaporation rates are plotted against steam pressure. Caliper and weight appear to have no marked effect on the drying rates. Other factors affecting drying rates are discussed.

295. Montgomery, A. E. Paper Tr.J.112.1941.T.A.P.P.I.131-4

ROSS CYCLE CONDITIONER FOR PAPER. Paper passes through two chambers, 1st with cool humid air, 2nd warm humid air, e.g. 95°F. 90% R.H., which brings paper rapidly to the required condition.

296. Montgomery, A. E. Paper Tr.J.114.22.41-44.28 May 1942

DRYING RATE FOR KRAFT PAPER. A re-survey in view of the installation of larger machines since 1933. Drying rates/steam pressures are not higher but steam pressures are higher than previously. Wide variation in drying rates are noted and discussed. See Paper Tr.J.96.11.p.32. 16/3/33. Montgomery.

1297. Montgomery, A. E. Paper Tr.Jnl.123.14.29-32.T.A.P.P.I. 155-158.1946

PAPER MACHINE DRYERS: HEAT TRANSFER CALCNS. A method is outlined for determining the overall thermal conductivity coefficient for paper machine dryers and the local conduction coefficients are evaluated. It is shewn that for all except the "Yankee" machines, contact conduction has the dominant effect on drying rate, but on the Yankee machines the conductance through the dryer shell has the greatest importance.

1298. Montgomery, A. E. and V. P. Ross, Eng.Corp. Paper Trade Jnl.129(9)22-5 Sept.1949

WASTE IN PAPER MILL DRYING AND VENTILATION. Points out how heat and steam are wasted in a 100 ton per 24 hours mill, through lack of proper hood, control, supervision, etc., and how the Ross-Briner economiser can recover the heat.

1299. Mueller, F. and Trenschel, R. Papier-Fabrikant, vol.28, nos.48 and 49, Nov.30, 1930, pp.812-819 and December 7, pp.825-830, 12 figs.

SURFACE TEMPERATURES AND WATER EVAPORATION ON DRYING SECTION OF PAPER MACHINES. Investigations carried out during past two years on two paper machines in order to study drying process; investigations of rotation-pressure paper machine; measurement of cylinder surface temperatures; machine for making grease-proof papers.

1300. Nordstrom, Loenck, O. Pappers Tidning 35 161-2, 161-6, 197-8, 201(1932)

Methods of drying sulfate pulp by means of gas from silicate of soda furnace.

1301. O'Brien, W. J. Paper Industry 14, 362(1932)

CONTROL OF STEAM IN PAPER DRYING. ADVANTAGES OF O'BRIEN SYSTEM.

1302. O'Donoghue, R. Paper Tr.J.117.3.31-36.22 July 1943

DRAINAGE AND STEAM FOR PAPER MACHINE DRYERS. Discusses the fundamental principles underlying the action of steam in dryers, and the causes of low heat transfer. Drainage systems are reviewed and dryer surface temperatures are analysed.

1303. Orr, W. H. Proc.Inst.of Mech.Engrs.141(2)p.139. 1939

THE MODERN PAPER-MAKING MACHINE.

304. Overbagh, J. S. and Birchard, W. H. — Paper Tr.Jnl.131(4)26-29.27 July 1950

CORROSION IN THE PAPER MILL. A general treatment of corrosion as related to operation and equipment. Tables of electrochemical series.

305. Papier-Fabrik Balsthal, A. G. — B.P.639,007.3.7.1947.Neth.25.10.1946

DRYING CYLINDERS FOR PAPER MACHINES. The cylinder is divided into longitudinal compartments having water inlets and outlets at the ends, adjacent compartments having the inlets at opposite ends.

306. Ross-Ross, D. — Paper Trade Jl.,Vol.92,no.8,Feb.19,1931, pp.106-109,8 figs.

LOW PRESSURE STEAM AND PAPER MACHINE DRYING. Advantages of "blow through" type of paper machine drainage system; typical installation in Beauharnois Division of Howard Smith Paper Mills, Ltd. Before Tech. Assn. Pulp and Paper Industry.

307. Sarco Co. Inc. — Paper Mill News 71.43.59.60.70.1948 B.II.Apr.1949

DRAINING AND AIR VENTING THE CYLINDERS OF PAPER MACHINES. The operation of the Sarco draining and venting system is described.

308. Schulze, R. — Papier-Fabrikant,vol.29,no.45,Nov.8,1931, pp.705-717,23 figs.

DRYING OF PAPERS AND FELTS AND ELIMINATION OF VAPORS AND FUMES BY MEANS OF HOT AIR. Results of extended tests; equipment for removal of vapors; results of experimental hot-air drying; influence of temperature of air on time required for drying; economy of hot-air drying.

309. Schulze, R. — Brennstoff u. Warmewirt 13(6)106-7.1931

VENTILATION OF PAPER MACHINE CYLINDERS. Recovery and Utilisation of Vapours, see also this Jnl. Jan. 1932 and Wochbl. Papier-fabr. 11 7=8.1931 Jan.21, for discussion.

310. Schulze, R. — Trans. in series in Pulp Paper Mag. Can.1932.No.12-17 in December 1932 issue

DRYING OF PAPER AND FELTS. Paper machine test data. Comparative tests on use of air jets on paper and on felts. (in Nov. issue).

311. Schmid, W. — Pappers-och Traevarutidskrift (Finnish Paper and Timber Jl.),(Helsingfors), No.19,Oct.15,1930,pp.874-876,1 fig.

DEHYDRATING PULP AND PAPER-COVERED SURFACE OF WET PRESSES. Means of effecting uniform dehydration in wet presses are discussed with particular regard to proper functioning of felt. (In German.)

1312. Stamm, F. C. Paper Mill, vol. 54. No. 8, Feb. 21, 1931, 5pp
between pp. 78-85, 3 figs.
DRIER CAPACITY. List of variable factors which have marked effect upon water evaporation; curve of drier temperatures showing driers in excellent condition; hypothetical curve showing effect of drier temperature on evaporation; rust and size accumulation on outside of driers; circulation within driers; curve of drier temperatures showing driers in bad condition; general observations of drier surface temperatures; theory of heat transfer. Before Tech. Assn Pulp and Paper Industry.

1313. Stamm, F. C. Paper Tr. J. 94. 17. 42-44. 28 Apr. 1932
EVALUATION OF PAPER BOARD DRYER PERFORMANCE. Recommended basis fo judging performance i.e. pounds of water evaporated per sq. ft. of drier surface per hour. Analysis of variables which affect dryer performance. Summary of data received from questionnaires.

1314. Stamm, F. C. Paper Tr. J. 106. 8. 103-107. 24 Feb. 1938
HOW MUCH DO WE KNOW ABOUT DRYING. Discusses the presence of air i the rollers, the sources and detection of the air. Suggestions fo further investigation into various aspects of drying.

1315. Stamm, F. C. Paper Tr. J. 113. 1941. T. A. P. P. I. 1-3
PAPER DRYING. Cockle and curl is a direct function of shrinkage. Graded temperatures on the rolls from 140°F upwards and then downwards at the cooling end will reduce curl and cockling.

1316. Togo Wochbl. Papierfabr. 63. 729-30. 24 Sept. 193
A NEW FAN DRYER FOR PAPER AND CELLULOSE.

1317. Tout, A. F. Chem. Engr. B'ham. University 2(1) 6-12
Autumn 1950
THE DRYING PROCESS IN PAPER MNFR. A general description of the various features in paper drying.

1318. United Wallpaper Inc. B. P. 627,234. 10/46
REMOVAL OF MOISTURE. Water removed in a few seconds from a moving sheet of paper or cloth, without scorching, by use of a number of open flames in a shroud.

1319. Wade, W. U. S. Dept. Commerce, Off. Tech. Serv.,
PBL80816, May 1947, 6pp., $1.00
DRYER USED ON UREA MOULDING MATERIALS. This report describes and illustrates in four photographs the drying of a wet mass of urea-formaldehyde impregnated pulp fibres by a Büttner "Turbo Dryer".

1320. Wallace, J. H. Paper Trade J. 95, No. 17, 44-8, 72 (1932)
VERTICAL STACK DRIERS WITHOUT DRIER FELTS ON FOURDRINIER MACHINES IN THE MIAMI VALLEY.

1321. Weber, C. G. Pulp & Paper Mag.Canada.50(2)67-69.1949
IMPORTANCE OF AIR CONDITIONING TO THE PAPER CONVERTER. Effect of moisture on the properties of paper and the advantages of Air-conditioning in printing, fabrication, etc.

1322. Wertheimer, R. S. Paper Trade Jnl.94(5)Feb.4.1932.pp.49-50
DRYING PAPER ON YANKEE DRYERS. DRYING RATES AND EFFECTS OF AIR AVERAGING. Interesting to Paper Trade. Dry bulb 190°F., W.B.105 (±5) found best. Higher dry bulbs do not increase rate. Outlet humidity of more than 40% reduced rates. Use of large quantity of moderate temp. air better than small of hotter. Desirable to maintain 40% outlet. Forced air increases rate 20 to 23% over natural convection.

1323. Westbrook, V. J. Paper Tr.Jnl.130(24)74.15.6.1950
MAINTENANCE OF ANTI-FRICTION BEARINGS IN PAPER MACHINE DRYER SECTIONS OF HIGH SPEED MACHINES.

1324. Western, A. W. Inst. of Fuel Drying Study March 1951
DRYING IN THE PAPER INDUSTRY. After a brief description of the paper making process, the author describes the equipment used in the drying section, and gives an account of the main types of temperature control systems followed by a discussion of the advantages of installing vapour-absorption plant to increase the amount of drying that can be done by a given number of cylinders. Reference is made to the methods of estimating drier efficiency, and the paper concludes with indications of the directions in which improvements in efficiency may be sought. A heat balance diagram is given.

1325. Witham Rheinhold Publ.Co.N.Y.2nd.Ed.1942
MODERN PULP AND PAPER MAKING.

1326. Young, G. H. Paper Tr.Jnl.125(26).T.S.314.1947
STEAM SUPPLY AND CONTROL ARRANGEMENTS FOR DRYERS. Description of arrangements with use of exhaust steam and with high pressure steam as used in the Yankee dryer. Methods of control are described.

1327. Young, G. H. Paper Mill News.72(30)p.28.23 July 1949
PAPER DRYING ON THE MACHINE. Description of the various dryer section and layouts. Discusses steam consumption, moisture content, etc.

328. Brown Instrument Co. Paper Mill News, 1946, 69, No. 37, 70-72 (through Brit. Abstr., 1947, B11, 262)

"MOIST-O-GRAPH" AUTOMATIC MOISTURE CONTROL APPARATUS: APPLICATION IN PAPER-MAKING. The application is described of the Moist-O-Graph, which is based on the variation of the electrical resistivity of paper with water content, and consists of a detector roll, a recording and indicating potentionmeter, and the power unit. Machine speed, ambient humidity, and machine-room ventilation, thickness, pH, and freeness have negligible effects on its operation but variations in the amount of filler, size and dye alter the reading of the instrument. Increase in the amount of filler decreases the slope of the moisture/resistance curve. Increase in the amount of size decreases the paper resistance for a given moisture content, the shift being practically linear. Change from a white to a heavily coloured sheet decreases the resistance appreciably. Temperature changes of 20^{O}F, or less are negligible. A static eliminator is incorporated to obviate trouble from these sources, whilst detector roll pressure should be kept as constant as possible. A comparative analysis of water-measuring systems available is tabulated.

329. Emerton, H. W. Br. Paper & Board Industry Research Assn. Rep. R. A. /T. 10. March 1951. D. S. I. R. 4717/B

SOME METHODS OF MEASURING MOISTURE IN PAPER. Results of the survey of the literature with a view to choosing or designing suitable instruments for research in the paper making industry, and for control work in the paper-mill. Electrical and beta radiation methods were evaluated.

330. Mather & Platt Ltd., and S. F. Barclay B. P. 589, 468 of 22. 3. 1945: 20. 6. 1947

DRYING MACHINE TEMPERATURE DIFFERENTIAL CONTROL DEVICE. A device for controlling the speed of travel of cloth or paper through a drying machine is based on the observation that the temperature of the material remains substantially constant until it is dry and then rapidly rises. The temperature differential is ascertained by thermocouples or pressure thermometers of the differential type brought into contact with the material about mid-way along the drying path and near the exit. The temperatures may be indicated or recorded and the thermometers may be associated with electronic devices to control the speed of travel.

331. Murphy, E. A., and Scholl, H. A. 5th Pulp & Paper Mnf. 11(2)45-50. 1948 BII. 537. Nov. 1948

CONTINUOUS MEASUREMENT OF PAPER SHEET MOISTURE. The Moist-O-Graph is based on electrical conductivity and operates up to speeds of 200 ft. per minute.

1332. Murphy, E. A. and Instrumentation 3(5)29-30.1948.Chem.Abstr.
Sholl, H. A. 43.15.1949
MODERN CONCEPTS OF PAPER DRYER CONTROL. Description of control instrumentation for paper dryer system in a paper-mill.

1333. Nordstrom, E. F. Paper Ind. 15,720(1934)March
TESTS ON THE AUTOMATIC CONTROL OF MOISTURE CONTENT OF PAPER. Shows tests where automatic humidity control gave satisfactory moisture content in product.

1334. Schaun, E. Wochbl.Papierfabr.1933,Sept.No.24-9
AUTOMATIC DRYING REGULATION BY THE SICCOMETER.

1335. Sholl, H. A. Paper Tr.Jnl.Indust.Dev.Sect.128.149-152.
1949
INSTRUMENTATION FOR PAPER MAKING AND CONVERTING. The applns. of instruments to pH., stock, and H_2O control, stock blending, size preparation, drying, machine speed, glue, weight, thickness and temperature recording are discussed.

Fundamental Principles

1336. Anon. Paper Tr.Jnl.110.1940.T.A.P.P.I.178-179
PAPER. MOISTURE EXPANSIVITY DETERMINATION. The cabinet is described wherein the increase in length due to R.H. and temperature controlled conditionsis measured by an optical lever or other device. Details of mechanism.

1337. Anon. Paper Trade J.,1947,125,T.A.P.P.I.93-96
PULP WOOD: DENSITY AND MOISTURE CONTENT. A Tentative Standard method for the determination of the specific gravity (or density) and moisture content is described, applicable to pulpwood chips and disks from the cross-section of logs. Since wood swells or shrinks respectively with the absorption or loss of water, it is necessary to express the specific gravity at specified conditions of moisture content and volume. The most usual conditions are the moisture-free weight and the maximum (green) or the minimum (moisture-free) volume. Procedures for obtaining the volume on both the green and moisture-free bases are described.

1338. Asada, T. and Oyo Butsuri,1943,12,64-66(through Chem.
Abe, M. Abstr.1947,41,5305^e)
PULPS: DIELECTRIC CONSTANT AND WATER CONTENT DETERMINATION.
Dielectric constants were determined with an arrangement depending on the increase in the capacity of a conductor when inserted between

the polar plates of a parallel-plate battery with a capacity compe sation device. Data are given for photographic glass plates, and polystyrene pressed into a plate after heating, or cooled into a plate after heating in vacuum. Pulp dried at 105°C. showed a dielectric constant of 1.57. After keeping the pulp at a known humidity for 24 hours, the dielectric constant was again determine The water content of the pulp, calculated from the increase in wei was found to be a linear function of the dielectric constant, obeying the Clausius-Mosotti equation between the density and dielectric constant for gases.

1339. Bialkowsky, H. W. Paper Tr.Jnl. 111-1940. TAPPI. 20-24
Probst, T. R.
PAPER. CHANGE OF DIMENSIONS WITH HUMIDITY. Description of appa Strips of paper are placed in glass tubes in series, air of the required condition is passed through and changes in dimension measured with a microscope. Samples change more in the cross dimension than in the longitudinal by 3 to 7 fold.

1340. Brecht, W. Papier 126-132. 1947. BII. 310. Aug. 1948.
MEASUREMENT OF WET STRENGTH.

1341. Brecht, W. Melliand Textilber, 1948, 29, 1-3
SPECIFICATIONS FOR MOISTURE CONTENT AND WATER ABSORPTION OF PAPERS
Formulae, tables, graphs, and a nomogram for the conversion of moisture content indicated by wt. of H_2O per 100 g. of dry substance (regain) into moisture content indicated by wt. of H_2O per 100 gr. of moist substance, and for calculation of dry wt. and H_2O absorption from either of these vals. are given.

1342. Brecht, W. Melliand Textilber, 1947, 28, 357-371
INFLUENCE OF MOISTURE AND WATER CONTENT ON THE TENSILE PROPERTIES SPINNING PAPER. Variations in the longitudinal and transverse tensile characteristics of a sulphite spinning paper (0.054 mm. thickness, 43.0 g. per sq.m.) over a range of H_2O contents from ni to saturation, have been determined and are given in graphical for The breaking load is a max. at 5% H_2O content, bursting strength a 8%, resistance to folding at 16%, tearing strength at 22%, and extensibility at 24%. See also Papier 3 189-192. 1949.

1343. Burstein, V. S. Paper Tr.Jnl. 122: 1946. TAPPI: 103-110
PAPER AND PAPER BOARD. RATE OF DRYING UNDER MACHINE CONDITIONS.
From a laboratory experimental study, the following implications a made concerning operation and design of paper machines. (a) the thermal resistance of the vapour layer is considerable. The thickness is governed by the tension of the paper and of the felt.

It is not practicable to increase the tension. (b) Effect of turbulence and R.H. on rate of drying is limited. The temp. of the air affects heat losses and is important. (c) Increased drying rates are in linear proportion to dryer temperature until free water reaches 212°F. Further increases in dryer temp. have less effect. The critical dryer temp. is probably well above 250°F. It will be lower with lower drying rates, with higher thermal conductivity of drying paper, and with thinner vapour layers.

344. Campbell — Pulp and Paper Mag. Canada. Convention No. 48. 103-9F. 1947.
PHYSICS OF WATER REMOVAL FROM PAPER.

345. Carson, F. T. — J.Res.Natl.Bur.Stds.24.435-442.1940
PAPER: PORE SIZE DETERMINATION. The various methods are reviewed. 1. Rate of efflux of fluids. 2. Rise in vertical strips. 3. Capillary pressure on penetration. A new method outlined concerns the coefficient of slip of air in viscous flow through paper as a function of pressure. Only necessary to determine the air permeability at two different pressures of an identical area of paper for pore radius to be calculated.

346. Caulfield, J. G. L., Jenness, L. C. and Macklem, H. G. — Paper Tr. Jnl. 108.24.27-29. 15 June 1939
THE EFFECT OF HYDRATION UPON THE RATE OF DRYING OF PAPER SHEETS. In the drying rate curves for sulphite pulp sheets, two critical moisture contents are displaced toward higher values by increased hydration.

347. Collins, T. T. — Paper Mill News 72.Nos.17 to 26.1949
WET STRENGTH OF PAPER. REVIEW OF THE LITERATURE.

348. Cowan, E. and Cowan, B. — Am.Soc.Mech.Engrs. Trans.58 N.8.Nov. 1936.p.711-25 (PRO.58-6)
THEORY OF PAPER DRYING. Theoretical formulas developed by authors for predicting performance of paper drying machines; results obtained by using these formulas; problems met with and how they can be dealt with theoretically in effort to predict performance of drying machines; fundamental equations for use in designing and perfecting new equipment. Bibliography. Discussion in this Jnl.59(5) 1 July, 1937.p.461-2.

1349. Flyate Bumazh.Prom.

1. 21 9/10 19-23 1946
2. 21 3/4 37-46 1946
3. 21 7/8 do. 1946

1. EFFECT OF PULP BEATING ON DRYING RATE. The effect of pulp beating had little effect on the drying rate during the constant rate period, or on the critical moisture content. It did affect the rate in the later stages. "Free pulp" dried in about 60% of the time of "slow pulp".
2. Drying rate curves for temperatures between 50°C and 130°C indicated two drying periods.
3. Operational conditions.

1350. Flyate Bumazh Prom.

1. 22 n2. 21-7 1947
2. 22 n4. 12-14 1947

1. Relation between weight of paper per sq.metre and its drying velocity.

Time in seconds = $K.g.^{1.238}$
K = function of cylinder temperature
g = paper weight in grams. per sq.metre

2. Relation of drying velocity to pulp composition. Chem.Abstr.4 6112. 1948.

Following a mathematical analysis of paper drying, it was found experimentally that using cans for drying, the drying time varied with the 1.25 power of the paper weight and inversely with some function of the temperature. Pulp composition was found to have little effect on the rate.

1351. Foote, N. M. Ind.Eng.Chem., 1947.39(12), 1642-6

VACUUM DRYING OF PAPER. Sorption isotherms for kraft capacitor tissue were studied by successively evacuating and re-establishing equilibrium within a large volume connected to paper samples through a vacuum stopcock. Severe drying conditions must be employed to obtain insulating paper of low water content. To determine the factors affecting the equilibria, and the rate of drying radio capacitors, tightly-rolled interleaved layers of metal foil and paper were vacuum dried in Pyrex test tubes. The samples were then shut from the remainder of the all-glass high vacuum system, which was evacuated with a diffusion pump, thus permitting an adjustment of the residual air-pressure throughout the whole system. By employing suitable dry ice or liquid air cold traps with intervening vacuum stopcocks, water could be pumped away from the paper, measured and condensed in a trap. Measurements of absorption equilibria were made by re-admitting some of this accumulated water to the paper. The data obtained give the rates at which water could be removed from the edge of the paper roll, the rate being nearly constant at each pressure. The values at high temperatures give an estimate of the heat of the desorption reaction, 14 kilocals. per mol. of water for average water content, which agrees with the value found in the literature. Decomposition is observed as the temperature is raised, and finally appears to supplant the final drying. Correction in 40 852.1948.

352. Fridori, E. Textil-Rund-schau, 1946, 1, 105-112
PAPER: MOISTURE REGAIN STRENGTH, AND EFFECT OF DRYING.
Technical Committee of the Swiss Paper-makers Association. Data are recorded for the rate at which specimens of paper came to equilibrium with an atmosphere at 20°C. and 65 per cent. R.H. along the absorption path (dried over silica gel) and the desorption path (starting from an atmosphere at 95 per cent R.H.), and also for the breaking load, extension at break, work of rupture, bursting pressure and height of the dome in the bursting test, of the same papers. The results are treated statistically and attention is called to the differences, especially in extension at break, between the "absorption" and "desorption" series.

353. Coupe, R. R. Proc. Technical Sect. of Br. Paper and Board Mnfrs. Asscn. 31.2.384-457.1950
THE AIR PERMEABILITY OF PAPER. A critical survey of the literature relating to air permeability of paper, given under eleven headings.

354. Garton, C. G. Br. Electr. and A.I.R.A. Tech. Rept. A/T.78 1940
THE ELECTRICAL PROPERTIES OF WATER ADSORBED BY PAPER.

355. Green, L. G. Paper Tr. Jnl. 110. 1940. TAPPI. 281-3
PULP DRYING RATES. The rates of drying, based on drying surface area, vary as a straight line function with steam pressures. Caliper and weight appear to have no marked effect on the rates. Rates are lower on long machines than on short machines. Other conditions that influence the drying rates are discussed.

356. Houtz, C. C. and McLean, D. A. J. Phys. Chem. 1941, 45, 111-127
PAPERS: HEAT OF WATER ADSORPTION. Stabilization of the moisture adsorption characteristics of two types of paper, one derived from linen and the other from kraft wood pulp, in the temperature range

from 100°C. and for equilibrium vapour pressures from zero to 25 mm. of mercury can be accomplished by heating the papers in the dry state for more than 40 and 120 hours, respectively, at 150°C. Increased time of heating in the dry state is found to decrease the adsorption of water vapour toward a reproducible minimum value, which is very nearly the same for both papers, but which is attaine in shorter time by the linen paper, and represents a greater decrease in adsorption for the kraft paper. The decrease in adsorption resulting from the stabilization treatment is unaffected by time, within the temperature and pressure limits encountered in measuring a series of isotherms. Adsorption isotherms are presente for the two papers in the temperature and pressure ranges stated above, and are found to fit the Freundlich adsorption equation except at very low moisture contents.

1357. Knight, G. D., TAPPI.33.59-66.1950
Dexter, C. H. & Sons Inc.
Windsor Locks. Conn.
WETTABILITY OF PAPER SURFACES BY WATER AND THE SURFACE ABSORPTION OF WATER BY PAPER. Refers also to penetration by ink.

1358. K. Lauer, L. Skark, and Kobiljanski, A. CelluloseChemie, 1944, 22, 136-137, (throug Chem. Abstr., 1948, 42, 4346e)
PULPS: EFFECT OF DRYING ON VISCOSITIES. The effects of various drying methods on cuprammonium and xanthate viscosities of a sulphite pulp sheet and a partially bleached pine sulphate pulp were studied. Whereas variations in drying caused some differences in the cuprammonium viscosity of the sulphite pulp sheet, the xanthate viscosities were more sharply affected.

1359. Lees, A. Proc. Tech. Sect. of Paper Makers Assoc. of G. B. & I. 28.583-98, 1947. Chem. Abstr. 5949. 10.8.49
HUMIDITY AND THE PAPER MAKER. Methods are described for the measurement of humidity, the calibration of instruments and the relation of humidity to paper making.

1360. Lewes, McAdams, and Adams Pulp & Paper Mag. Canada 25. 122-128. 1927
FUNDAMENTAL FACTORS IN THE DRYING OF PAPER PRODUCTS. Temperature of the sheet is measured and coeff. of heat flow from steam to sheet calculated. 33 B.T.U/hour/sq. ft. /°F. (Chem. Eng. Handbook 1941

1361. Lyne, L. H. and Gallay, W. T.A.P.P.I.33(9)429-435.Sept.1950
EFFECT OF DRYING AND HEATING ON THE SWELLING OF CELLULOSE FIBRES AND PAPER STRENGTH. The effects of heating and drying on the loss of swelling power and consequent loss of bonding.

1362. McKee and Shotwell Paper Tr.J.94.33-37.1932
EQUILIBRIUM BETWEEN PAPER MOISTURE CONTENT AND HUMIDITY. The rate of moisture regain.

1363. McReady, D. W. Paper Trade J.95,31-6(1932),Sept.15,No.11
DRYING OF PULP AND PAPER.- I. MECHANISM OF AIR DRYING. Qualitative discussion of the four mechanisms of drying. Data on pulp slabs of various porosity, and asbestos slab. Effect of density.

1364. Minton, O. TAPPI(1)249--53.May 1951
EXPERIMENTAL DATA ON THE EFFECT OF DRYING TEMPERATURES. See also Pulp and Paper Mag. Canada, 31.579-598.604.622 and Paper Tr. Jnl.93 ([illegible]) 42-6.1931.

1365. Mull, W. Papier-Fabr.30,Tech.-wiss,Teil 701-4, 725-9,737-42,749-51(1932)
THE REMOVAL OF WATER FROM PAPER ON THE FELT-COVERED DRYING CYLINDERS OF THE PAPER MACHINE. The factors (porosity, absorbency, thickness, etc.) capable of influencing the removal of water from papers were detd. for a no. of felts, and miniature drying tests made with the same felts and several grades of paper. From these data the effect of felt characteristics on drying performance could be evaluated.

1366. Richtor, G. A. U.S.Pat.667,105.Official Gaz.561)1949) Chem.Abstr.43.9445.1949
DRYING PROCESS FOR SHEETED CELLULOSE PULP FOR ACETYLATION AND THE LIKE. Shrinkage and physical impairment of moist sheeted cellulose (especially high-alpha wood pulp) during drying, e.g. to 5% moisture content, is avoided by conducting the drying operation in such a fashion that the gaseous drying medium, e.g., air, has, as it comes from the drying sect'n. a R.H. of not less than 50%. Data relating to drying operations e.g. temp. of air, rate of passing through the sheet, evapn. rate, dryer length, are tabulated.

1367. Sapp, J. E. and Gillespie, W. F. Paper Trade J.,1947,124,No.9,120,122,124 126
PAPER: STRENGTH; INFLUENCE OF TENSION DURING DRYING. The loss in bursting strength on a Fourdrinier machine was found to be approximately 16 per cent. on the wet end and 20 per cent. in the drier section. When hand-sheets are dried under unidirectional tension, large losses in bursting strength may occur, the loss being dependent upon the amount of tension during drying and, to a certain

extent, upon the degree of refining of the pulp. Consideration of the changes in tensile strength and per cent. elongation brought about by drying under tension leads to the conclusion that loss in bursting strength is caused chiefly by decrease in per cent. elongation in the direction in which tension is applied, with decrease in tensile strength a contributing factor if the sheet is dried under excessive tension. These changes are caused not by distortion of the wet sheet but by drying it while so distorted. Handsheets dri under unidirectional tension are much more like machine-made paper than are handsheets made according to the usual procedures.

1368. Schopper, L. Papier-Fabrikant (Berlin), 23. No. 38, Sept. 21, 1930, pp. 597-602, 11 figs.
APPARATUS FOR DETERMINATION OF DEWATERING RAPIDITY FOR PAPER PULP, CELLULOSE AND WOOD PULP. Schopper-Riegler patented fineness-degre tester has been fitted with auxiliary device; valve cone, heretofore removed by hand, is now operated by mechanical lifting device for purpose of obtaining greater uniformity of test results.

1369. Sheehan, J. A. Paper Trade J v. 102. n. 13. Mar. 26. 1936 p. 37-9
CONTROL OF MOISTURE-CONTENT IN PAPER UNDERGOING PROCESS OF PROGRESSIVE DRYING. Simple and accurate method of moisture determination in paper during its manufacture and means to control it; rate of evaporation during various stages of drying visualized by means of curves; typical graphical records of moisture content as determine by this method. Before Tech. Assn. Pulp and Paper Industry.

1370. Sherwood, T. K. Paper Tr. J. 88. 8. 134-6' 21 Feb. 1929
MECHANISM OF DRYING PULP AND PAPER. Discussion of the factors affecting drying, air film thickness, air velocity, etc. Drying on drum dryers and factors affecting efficiency.

1371. T. K. Sherwood Ind. & Eng. Chem. 22. 130-136. 1930
THE DRYING OF SOLIDS. III. Mechanism of Drying Paper and Pulp. S also Trans. Inst. Chem. Engrs. 23. 28. 1929. The rate of drying is sh to be independent of sheet thickness for thin sheets such as newsprint. The air velocity has an important effect on the rate over t whole range; the rate of drying increases rapidly with sheet speed.

1372. Sherwood, T. K., Paper Tr. J. 106. 24. 29-35. 16 June 1933
Gardner, H. S. and
Whitney, R. P.
WATER REMOVAL FROM PULP AND PAPER. Periods of constant and fallin rate are indicated from data obtained from the Fourdrinier and pres section of a sulphite pulp mill. It is calculated that 80% of the water passes to the felts while in contact with the rolls. The importance of the felts is discussed.

373. Simmonds, F. A. Paper Trade J. 96, No. 20, 31-5(1933)
A SURVEY OF THE LABORATORY TESTING OF PAPER AND CELLULOSIC PAPER-MAKING MATERIALS. A Survey of the literature on the drying of paper and cellulosic paper-making materials for the phys. and chem. testing used in the evaluation of pulpwood, pulp, stuff or paper, with bibliography of 31 references. Conclusions: In detg. the "dry" content of pulp, etc., contg. no volatile constituents, the sample may be heated at 105°C for 4 hrs. without causing appreciable error from chem. changes in the samples; but it is not advisable to heat more than 5 hrs. at 105°. Volatile matter commonly found in some types of cellulosic material introduces an error when drying is affected by heating at 105° C.

374. Simmonds, F. A. Paper Tr.J. 97.40-41.7 Sept.1933
CAPILLARY RISE OF WATER IN FIBROUS SHEETS AND POSSIBLE APPLICATIONS. e.g., to detn. of effective capillary diameters, to swelling velocity co-efficient for predicting rate of hydration during heating. Suggestions for further investigations.

375. Stamm, F. C. Paper Mill, vol.54, no.20 and 24, June 13, 1931, pp.5, 20 and 22.
FACTORS IN DRYER PERFORMANCE. Factors affecting heat transfer through drier shell. Before Am. Pulp and Paper Mill Superintendents Assn. See also Paper Trade Journal 92.83-5.1931.

376. Stamm, F. C. Paper Trade Jl., vol.92, No.12, Mar.19, 1931, pp.64-67, 3 figs.
HEAT TRANSFER THROUGH CAST IRON DRIER SHELLS. Before Tech. Assn. Pulp and Paper Industry, previously indexed from Paper Mill, Feb.21, 1931.

377. Stamm, F. C. Paper Trade J.v.100.n.2.Jan.10.1935. p.40-2
FACTORS GOVERNING HEAT TRANSFER THROUGH DRIER SHELLS. Data compiled by TAPPI Heat and Power Committee on fundamentals of paper drying; variables that affect heat transfer, most important of which, are accumulation of air within drier and percentage of moisture in sheet leaving wet end of paper machine. Bibliography. Before Tech. Assn. Pulp and Paper Industry.

378. Sutezo Oguri, J. Soc.Chem.Ind., Japan 35, Suppl.binding 232-4(1932)
HYGROSCOPIC MOISTURE OF CELLULOSE. V. DRYING CELLULOSES. Drying various types of cellulose by (1) heating at 105°C. (2) in vacuo over P_2O_5 and (3) in vacuo, showed (2) to be most effective and (1) next, but the effectiveness varied with different samples. VI. Hygroscopic moisture of raw cotton and tissue paper. Ibid 235-9.

In general cellulose with a low hygroscopicity expels moisture by
the vacuum method as well as by the heating method. The hygrosco
city expels moisture by the vacuum method as well as by the heatir
method. The hygroscopicities of raw cotton and tissue paper prep
from cotton are approx. equal, but greater than that of standard
cotton cellulose (cf. C. A. 25, 5285). VII. Hygroscopic moistu
of bamboo cellulose. Ibid 239-44. Bamboo.

1379. Thomas, W. R. Br.Paper and Board R.A.Report.R.A.T/1.
Dec.1947.84pp.32 refs.

A SURVEY OF THE PHYSICS OF THE FLOW OF FLUIDS IN POROUS MEDIA, WIT
SPECIAL REFERENCE TO THE REMOVAL OF WATER BY MECHANICAL MEANS FROM
PAPER AND RELATED PRODUCTS.

- Basic relationships. Theory of dimensions.
- Dovey's law. Its validity. Permeability of a porous medium. Detn. of pore dimensions. Specific resistance c a porous medium.
- Application of theory to fluid flow through Paper. Remova by various means.

1380. Thomas, W. R. and Bennett, W. E. Br.Paper and Board.Ind.R.A.T.19.Sept. 1950.105pp.

A SURVEY OF THE PHYSICS OF DRYING OF POROUS MATERIALS WITH SPECIAL REFERENCE TO DRYING OF PAPER ON THE MACHINE. The chapters deal with 1. General Considerations in the drying of paper. 2. Steam conditions and heat transfer. 3. The physical processes involved 4. The drying mechanisms involved. 5. Drying rates on paper and board machines. A mathematical treatment is included in 3, 4 and 5 and a bibliography accompanies each chapter.

1381. Waters, V. F. Paper Trade J v.102.n.8 Feb.20 1936.p. and 122.

RATE OF DRYING OF GLASSINE AND GREASEPROOF PAPER. Method of calculation; discussion of results. Bibliography. Before Tech. Assn. Pulp and Paper Industry.

1382. Winter, C. Papier.145-171.1947.B.II.309.Aug.1948

EFFECT OF MOISTURE ON WET STRENGTH. Bursting, tensile, folding ar
tearing strength of sulphite spinning paper compared with those wit
normal water content.

1383. Woods, J. P. Pulp Paper Mag.Can.50.4.70-74.1949

HYPOTHETICAL APPLICATION OF A HEAT PUMP TO PAPER MACHINE DRYERS.
The hypothetical application of a heat pump to the drying section i
described, as a basis for the theoretical analysis of the drying on
a typical newsprint machine. Considerable theoretical savings
indicated have not been realised in practice.

1384. Wrist, P. E. British Paper & Board Inds.Res.Assoc. Rep.RA/T/21.D.S.I.R.4249/B.Feb.1951
TEMPERATURE MEASUREMENT AS APPLIED TO THE DRYING SECTION OF THE PAPER MAKING MACHINE. A survey of the methods of temperature measurement available for use on the paper drying section, and an assessment of their value. The development of new instruments is discussed.

iffusion and Permeability

1385. ---- Pulp & Paper Mag.Can.32.160-7.1932
PENETRATION OF LIQUIDS INTO WOOD PULP AND PAPER.

1386. ---- Paper Tr.Jnl.III.1940.TAPPI.61-63
PAPER. WATER VAPOUR PERMEABILITY. Details of apparatus for determination of permeability of paper and board as specified in T.A.P.P.I. tentative standard. T.448.m.40. See also under B Brabender.

1387. Aiken Paper Tr.Jnl.125(14)31.2 Oct.1947
METHOD FOR MEASUREMENT OF WATER VAPOUR PERMEABILITY AT LOW TEMPERATURES. Discussed factors affecting low temperature determinations.

1388. Babbitt, J. D. Canad.J.Res.A.1940,18,90,97
THE PERMEABILITY OF BUILDING PAPERS TO WATER VAPOUR. Some measurements of the permeability of various types of building papers to water vapour are reported, with a short discussion of the efficiency of the papers as vapour barriers.

1389. Brabender, G. J. Paper Tr.J.1940.110(No. 18)27:Chem.Abstr. 1940,34.4264.
WATER VAPOUR PERMEABILITY. PROGRESS REPORT OF THE T.A.P.P.I. SUB-COMMITTEE ON WATER VAPOUR PERMEABILITY. Gives a detailed description of a method for determining the water vapour permeability of a sheet when the two faces are exposed, respectively, to (1) a high humidity on one face and a medium humidity on the other and (2) a medium humidity on the one face and a low humidity on the other. Duplicate determinations should check within ±10%.

390. Carson, F. T. Paper Trade.J.1947.125,No.19. 118,120 122,124,126,128.
PAPER: WATER VAPOUR PERMEABILITY DETERMINATION BY GRAVIMETRIC METHOD. The evolution of the gravimetric (weighed-cell) method of determining water vapour permeability is outlined and methods of sealing the specimen to the cell, definition of the test area, ventilation of the surfaces of the specimen, condensation of moisture, desiccant in cell, vapour-pressure and moisture gradients,

steady-state region, use of counterpoise, acceleration of the test by increasing temperature, and agreement among common methods, are discussed. Data from published reports indicate that modification of the weighed-cell method, differing in details that may seem unimportant, often give results that differ by several hundred per cent., but that, when a well chosen procedure is rigidly adhered to the agreement should be within 25 to 30 per cent.

1391. Cherepow, F. H. Paper Trade J., 1947, 125, No. 19. 110, 112, 114, 116, 118

PAPER: WATER VAPOUR PERMEABILITY DETERMINATION BY FLOW METHOD. An adaptation of the isostatic method for determining gas permeabil (see Summary, 1946, p.415) is used to measure water vapour permeability at 0°F. Air is saturated with water vapour at 0°F. and passed at a known rate over one side of a series of test sheets hel in a diffusion cell maintained at 0°F. Air, dried to essentially 0 per cent. R.H. at 0°F., is passed over the other side. The wate vapour in each effluent stream is continuously absorbed in desiccan and the amount determined gravimetrically. Permeability is measured by the rate of gain of water vapour in the dry air. Comparison of total water vapour in both streams on exit from the cell with theoretical amount entering the cell serves as a check on the accuracy of the determination.

1392. Institute of Paper Chemistry Paper Trade J., 1940. 110. T. A. P. P. I. 42-48

PAPER: PENETRATION BY LIQUIDS. Current theoretical descriptions of the flow of liquids and solutions through porous material such a paper are summarised under the heading (1) laminar and turbulent flow through cylindrical capillaries, (2) laminar flow into a cylindrical capillary, (3) flow through combinations of cylindrical capillaries, (4) flow in non-cylindrical capillaries, (5) dimension of equivalent capillaries, (6) theory of wetting, (7) penetration into paper, and (8) statistical descriptions of penetration. Transudation and other practical tests on paper are discussed in the light of the theories.

1393. Inst. of Paper Chemistry Paper Tr.Jnl. 1943. 116(14) 11-15. (23) 10-13

PAPER: MEASUREMENT OF PERMEABILITY. Principles are discussed. A mathematical analysis of the method and its errors where the specimen covers a dish containing salt solution or a desiccant. There appears to be no general order of procedure which will ensure a good order of accuracy. A glass three compartment vessel is proposed, containing a standard diffusion resistance.

1394. Institute of Paper Chemistry   Paper Tr.Jnl.118.1944.TAPPI.11-17
PAPER: MEASUREMENT OF WATER VAPOUR PERMEABILITY. A variation of the cup method for creased and uncreased materials is described. Specimens at 100^{o}F with faces exposed to R.H's of 92% and 23%. The appln. of an electric hygrometer to the control of a room or a cabinet and an electronic amplifier control is described.

395. Inst. of Paper Chemistry   Paper Tr.Jnl.121(13)68.1945.TAPPI.151-160
PAPER: VAPOUR AND GAS PERMEABILITY DETERMINATION. A bibliographical study is presented of methods and instruments for above.

396. Inst. of Paper Chemistry   Paper Tr.Jnl.122.1946.TAPPI.1-10 1946.
J.Text.Inst.Abstr.A.161.37.1946
PAPER: WATER VAPOUR PERMEABILITY MEASUREMENT. Two electric methods are described. (1) The steady state method. (2) The dynamic method. Data by the two methods are presented.

397. Lehman-Oliva W.   Z.Ver.Deut.Ing.1.25-31.1940.Chem.Abstr.34.7107.1940
PAPER AND CARDBOARD. DIFFUSION OF MOIST AIR THROUGH - A method is described for the measurement of the diffusion constant for moist air in card or paper. A smooth surface presents greater resistance to diffusion than a rough one.

398. Simmonds, F. A.   Paper Trade J.97,No.10,40-2(1933)
CAPILLARY RISE OF WATER IN FIBROUS SHEETS AND POSSIBLE APPLICATIONS. There is a definite relationship between the time and height of capillary rise of water in strips of certain types of pulp and paper sheets, which can be used as a means of measuring the effective capillary diam. parallel to the upper and lower surfaces of a sheet. With paper, the ratios of the values in the machine and cross directions are suggested as a possible indication of the uniformity of the pores and sheet structure. Water is unsuited for testing calendered and sized papers in this manner since the sorption is too slow.

[illegible]. Vincent, H. L.   Paper Tr.Jnl.110.1940.TAPPI.293-297
PAPER: PERMEABILITY TO LIQUIDS: PHOTOELECTRIC DETERMINATION. Description of an instrument wherein the change in transparency with penetration of moisture into the capillaries is measured photoelectrically. Various organic penetrants were tried. Mathematical expressions for penetrability.

Infra-Red Heating

1400. Barber, J. J. Pulp & Paper Mag. of Canada.79-83.1948.
B.I.353.1948.Paper to Ann.Meeting of
Tech.Sect.Can.Pulp & Pap.Assn.29.30.
28 Jan.1948

CONSIDERATIONS OF RADIANT ENERGY AND MOISTURE REMOVAL. Results of investigation on the depth of penetration of radiant energy in pape It appeared that the effect of radiant heat at a depth of $\frac{1}{8}$ inch wa approx. 25% of that of conductive heat. At $\frac{1}{4}$ inch depth, radiant heat produced higher temperatures than convective heat. See also under "Board".

1401. Broughton, G. Paper Tr.Jnl.131(17)23-6.26/10/1950
INFRA-RED HEATING AND DRYING. Discussion of principles of application of infra-red to paper-making. See 133 27 July 1951.

1402. Kampen van, G. R. Paper Tr.Jnl.128(14)26-7.7 Apr.1949
BETTER DRYING AT LOW COST. Points out the advantage of infra-red addition to drying installations. Increase of drying capacity 10-15%, and the generation of the heat at the point of application.

1403. Kampen van, G. R. Pulp & Paper Mag.Canada pp.82-83.Aug.19
APPLICATIONS OF GAS BURNERS FOR INCREASED PAPER DRYING. A general appreciation of the advantages of infra-red drying of paper.

1404. United Wallpaper Inc. B.P.627,234.10/46
REMOVAL OF MOISTURE (FROM FIBROUS SHEETS). Water is removed from a moving horizontal sheet of wallpaper or cloth within a few seconds without scorching, by use of a number of open flames in a shroud.

Ultra Sonics

1405. Anon. Pulp and Paper Bulletin; Paper Maker,
1948,May,p.277

SOUND DRYING. ULTRASONIC DRYERS. The Ultrasonic dryer is a powerful sound-making machine. When operating, a rapidly rotating disc forces the air out through holes round its rim, and this air is cut by vanes in another stationary disc, the pulses passing through acoustic horns and setting up ultrasonic vibrations. These vibrations are then applied to the paper to be dried, agitating it and knocking off the water.

Lethal Effects of Rolls

1406. J. W. Appling, Paper Trade J., 1942, 114, TAPPI, 152-156
Shema, B. F.
BACTERIA: LETHAL EFFECT OF DRIER ROLLS ON -. The lethal effect of drier rolls has been studied by inoculating the wet web of an experimental Foudrinier machine with known species of bacteria, by determining the bacterial content of peel-off liners from four types of paperboard, and by determining the heat resistance of five different cultures of spore-forming bacteria in vitro and in paperboard. When the wet web of a Foudrinier machine was inoculated with Escherichia coli (a heat-resistant strain), Serratia marcescens, Staphylococcus aureus, Aerobacter aerogenes, and with mixed suspensions containing the first three nonspore-forming species in addition to Bacillus mycoides (a spore-former), it was found that only the spore-forming species survived the drier rolls. Large numbers of bacteria were found in both top and bottom liners when these were made from highly contaminated stock, such as waste paper. The drier rolls did not have sufficient lethal effect to sterilize highly contaminated stock, although the latter was heated by direct contact with the rolls. The following conclusion are drawn: (1) Spore-forming bacteria, such as Bacillus mycoides and Bacillus megatherium, are capable of surviving a much longer period of exposure to moist heat in paperboard than in vitro. (2) The resistance of these bacteria to heat in vitro is often too great for sterility to be expected within the practical limits used on the drier rolls. (3) The resistance of these bacteria in paperboards is too great to obtain paperboard of a bacterial content less than 250 per gram if relatively large numbers of these bacteria are present in the wet web. (4) The heat resistance of a species of a bacteria isolated from paperboard may be much greater than that of a normal species.

407. Shema, R. F. TAPPI.33(2)81-83. Feb. 1950
FURTHER STUDIES ON LETHAL EFFECT OF DRIER ROLL TEMPERATURE UPON BACTERIA IN PAPERBOARD. Heat of rolls is high enough to kill all colifora present in the sheet.

oated Paper

08. Argy, M. Papeterie 70.289.1948
Reviews the operation of the Spiral Dryer for coated paper.

09. Corcoran, J. C. Paper Trade J.94 n.3 Jan.21 1932 p.24 and 26
DRYING SURFACE SIZED PAPERS. Drying by holding between cotton felt passing over heated roll. Review of McCorkindale drying methods together with operating details of equipment.

1410. Davis, J. D. Paper Tr.J. 113.1941.TAPPI.17-21
COATED PAPERS. MOISTURE CONTENT AND RATE OF REGAIN. Equilibrium content is affected by stockcoat, weight ratio. Regains for various coatings.

1411. Hendrick, Van Nort Paper Ind.& Paper World.29.1297-1300.194
BII.308.Aug.1948
AIR DRYING OF SURFACE SIZED SHEET AT HAMMERMILL. Electrically controlled tub sizing plant dried 900 ft. min. with hot air drier and 600 ft. min. for production of high grade sized paper.

1412. Major, H. V. Paper Maker (London)110(48)51-60. 1945
REVIEW OF METHODS FOR DRYING COATED PAPER.

1413. Milham, E. G. and Balch, S. Paper Trade J.v.94.n.7.Feb.18,1932,p.145
7 and 9
HEAT REQUIREMENTS FOR DRYING COATED PAPER. Characteristics of four drying periods; flowing, setting, evaporation and cooling; drying systems, operating conditions, moisture carrying capacity of air. Before Tech. Assn. Pulp and Paper Industry.

1414. Davis, H. G. Paper Industry & Paper World 31(5)596-9
607.Aug.1949
HIGH SPEED COATING OF REPRODUCTION PAPERS. Illustrated description of a high speed coating machine installed by General Aniline and Fil Corp.

1415. Partsch, F. W. Paper Trade.J.v.105.n.1 July 1,1937.
p.106-7
EVOLUTION OF SIZED PAPER DRYING. Review of system used in drying of papers; Web and Barbour driers briefly discussed; tension controlled Barbour loft. Before Am. Pulp and Paper Mill Superintendents' Assn.

1416. Rappolt, H. G. Paper Trade J.v.94.n.5.Feb.4,1932.p.46-9
HANDLING AND DRYING OF SINGLE COATED PAPER. Outline of drying advances and mechanical improvements made; drying principles, new reflex system, drying enclosures, multiple unit lines, automatic temperature and humidity control; drying economy. Before Tech. Assn. Pulp and Paper Industry.

Board

Anon. Chem.Eng.News.27(10)685.7/3/1949
Electronic detection of moisture penetration of board, by means of a needle point in the board. The circuit is closed when the moisture reaches the needle point.

1418. —— B.I.O.S.Report 838.p.11
Some drying times are given for hanging and for flat dryers.

1419. ---- B.I.O.S.Report 989. 140 pp.
GERMAN FIBRE BUILDING BOARD MANUFACTURE. 60 pp. Description in English. 80 pp. of illustr. diagrams, and descriptions in German.

1420. —— B.I.O.S.Report 1526
GERMAN MANUFACTURE OF WOOD WASTE BOARD. (8) Schilde turbo-dryer reduces moisture to 8%. Few details.

1421. Holden, A. S. T.A.P.P.I. 32. 259-264. 1949
DRYING OF LOW DENSITY FIBRE BOARDS IN ROLLER DRYERS. Experience over the last 20 years is discussed with data on physical characteristics and air conditions.

1422. Montgomery, A. E. T.A.P.P.I. Ann.Meeting 1933
PERFORMANCE DATA ON BOARD AND KRAFT PAPER DRIERS.

1423. Montgomery, A. E. Pulp & Paper Mag. Canada.Convention No. 48.171-4F.1947
PAPER BOARD DRYING. Factors influencing the drying of paper board and heat transfer are discussed.

424. Radiant Heating Ltd. Ind.Heating Engr. 10(44)215.Nov.1948
CONTINUOUS PRODUCTION OF COMPRESSED STRAWBOARD. Ceramic gas burners wholly incandescent at 1600°F. are used.

425. Rengew, K. Svensk Pappers-Tidning (Stockholm), vol.33,no.18,Sept.30,1930,pp.723-724, 3 figs.
POSSIBILITIES OF ANTIQUATED PAPER-BOARD DRYING TROUGHS TO INCREASE EFFICIENCY. By hanging paper boards crosswise in drying troughs, and re-arranging air inlets and outlets, efficiency may be greatly increased. (In German).

426. Stamm, F. C. Tech.Assoc.Paper Makers Series 15.208-10 1932
EVALUATION OF PAPER BOARD DRYER PERFORMANCE.

428. Thuemmel, O. Tonindustrie-Ztg. 56.No.94.Nov.21.1932 p.1159-61
DRYING OF GYPSUM BOARDS. Methods employed in artificial drying; continuous drying in tunnel kilns.

1429. Uchastkina, Z. V. Bumazh Prom. 23(1)35-37 1948. Chem. Abstr. 42.9175. Nov. 1948

DRYING BOARD WITH RADIANT HEAT. Moisture reduced from 48% to 10% Moisture in 24 minutes by 500 watt lamp at a distance of 7.5 cms. The sample was 2 m.m. thick and 12 sq. cms. in area.

1430. Ulm, R. W. K. Paper Trade J., 1940, III, TAPPI, 225-227.

PAPERBOARD: RADIANT HEAT DRYING. An account is given of investiga tions of the drying of paperboard by radiant heat. A sheet of paperboard which had been soaked in water was suspended vertically from a balance in a chimney made of corrugated board and was illumi nated from each side by four 250-w. heat lamps of the type built with internal reflectors. The loss in weight was determined at intervals. The effect of distance of lamps on rate of drying and the effects of ventilation on sheet temperature and rate of drying were studied. The results are shown graphically and discussed. The moisture content-time of illumination curves indicate a constan rate of drying in the period about 20 sec. to 200 sec. illumination time, after which the rate of drying decreases.

1431. Weil, C. Paper Ind. 16, 630-3(1934) Dec.

SHEET DRYERS FOR BINERS AND FIBER BOARD. Advantages and Disadvantages of different types of periodically and continuously operated mechanical dryers.

1432. Whittemore, E. R., Indus. & Eng. Chem. v. 27. n. 7. July 1935.
Overmand, C. B., p.831-3
Wingfield, B.

SEMI-COMMERCIAL DRYING OF PRESSBOARD BY MEASURING ITS ELECTRICAL RESISTANCE. In production of pressboards from cornstalks, it was necessary to develop method for determining maximum moisture content at which boards can be safely removed from hot press without develop ment of steam blisters from underdrying; following platen and boar temperatures or making time-moisture curve is unsatisfactory, but measurement of electrical resistance is feasible.

1433. Wink, W. A. and Paper Tr. J. 127(10)35-6. 2/10/1948
Akker. van der, J. A.

AN ACCELERATED METHOD FOR MEASURING THE PENETRATION OF WATER IN INSULATION BOARD. Measurement of rate of penetration and distribution of water in the board.

Process and Equipment

1434. Anon. Rayon Textile Monthly (Formerly Rayon and Melliand Textile Monthly) 17 No.7 July, 1936 p.445-6.
TEXTILE DRYING APPARATUS. Principles of design and operation.

1435. Anon. Textile Weekly 31 133-136, 139 1943
DRYING APPARATUS. CONTROL. Reduction in steam consumption by insulation and by increase in air temperature issuing from the dryer. Operating conditions are discussed and the advantages of control are pointed out.

1436. Anon. Silk J. and Rayon World. 1944-5. 21 No.246 39-41. No.247 40-41
FABRIC DRYING MACHINES. A broad review of mangles, centrifuges extractors, cylinder and air drying machines, the Palmer machine, the Buti or Weisbach drum, and the Walker & Sons cell drying machine.

1437. Anon. Silk J. and Rayon World 1944-5 21 No.248 34-37
CLOTH DRYING MACHINES. A review, with illustrations, of recent types of clip and pin stenters and multi-layer stenters, drying machines for woollen & worsteds and tubular dryers for hosiery.

1438. Anon. Silk and Rayon, 1948, 22, 254-260, 546-550, 849-852.
TEXTILE FABRICS: DRYING. A concise survey, containing graphical and tabulated data, is presented on the subject of the absorption of moisture and other liquids by various textile fabrics, with a view to clarifying what has to be achieved in drying them. The conclusion is drawn that the residual amount of water on a fabric is determined first by the mechanical efficiency of the mangle, hydro-extractor or other apparatus used; secondly by the absorbent character of the textile material itself; and thirdly by the amount of water held chemically combined by the fibres. (2) The special treatment required by rayon fabrics in mangling is discussed, and (3) the advantages of vertical or horizontal hydro-extraction are reviewed.

1439. Anon. Silk and Rayon, 1949, 23, 134, 137.
OPEN WIDTH SUCTION DRYER: SUITABILITY FOR FINE RAYONS. The suction dryer is based on the principle that loosely adhering water can be sucked out of a fabric while it is being drawn at a steady rate in open width over a slotted or perforated plate or tube in communication with a vacuum pump. It is less efficient than a mangle or a hydro-extractor but most suitable for delicate fabrics.

1441. —— B.I.O.S.Report No.366

GERMAN TEXTILE DYEING, DRYING AND FINISHING MACHINES. A steaming m/c, a decatising m/c and a brushing m/c found in use by a German firm of dyers and finishers are of outstanding interest and are described in some detail. Visits to firms of textile engineers resulted in no useful information being gained.

1442. —— B.I.O.S.Report 452

DRYING MACHINERY (GERMANY) FOR SILK, RAYON, COTTON AND PAPER BOARD

1443. —— B.I.O.S.Report No.514

P. 53. Very brief description of a Haubold machine 80 metres long, capacity 200 metres a minute. Selenium cell equipped, and a usefu contrivance for unrolling curled selve edges.

1444. —— F.I.A.T.Rep.644

DYEING AND FINISHING METHODS IN GERMANY. p.90. Haas Loop Drying Equipment.

1445. Atkinson, G. L. Silk and Rayon 11 No.4 Apr.1937.p.338 and 336.

NOTES ON CAN DRYING FABRICS. Difficulties which arise, particular with cloths for printing, are discussed and remedies suggested.

1446. Barclay, S. F. Inst.of Fuel.Drying Study.March 1951

STENTERING MACHINES. The historical development of design is outlined; special mention of the introduction some 25 years ago of the use of superheated water vapour as a drying agent. Factors influencing the rate of drying are examined, drying efficiency is defined, and recommendations are made for improving the performance of existing machines. Curves relating the chief variables are presented.

1447. Blickman, S. Am.Dyestuff Reporter 26 No.21 Oct.18 1937 p.643-4

STAINLESS STEEL DRYING CYLINDERS. Use of stainless steel for textile cylinder drying equipment.

1448. Casey, C. H., Inst.Text.Technol.Research Rept.10 29-3
Feil, R. and 39-53.1948

SURVEY ON THE COSTS OF DRYING TEXTILE MATERIALS.

1449. Clark, C. H. Rayon Textile Monthly 17 No.9 Sept.1936 p.571-2

PROGRESS REVIEW OF AMERICAN TEXTILE RESEARCH. Work of U.S. Institu for Textile Research; warp sizing study; synthetic yarn sizing; sizing of rayon; textile drying project.

1450. Clegg, R. R. Inst. of Fuel.Drying Study March 1951
DRYING IN THE TEXTILE, PAPER AND ALLIED INDUSTRIES. After reviewing the various classes of dryers available, the author examines the relation between the nature of the stock and the design of plant, both for loose form and unit-form stock. Brief references are made to equipment in dyeworks and laundries and for hosiery, and a critical comparison is made between dryers operating on conduction and on convection principles.

1451. Dalglish, J., & Sons. Silk and Rayon, 1949, 23, 324, 326.
DOUBLE LAYER PIN STENTER. An illustrated description of the new pin stenter. (See Summary, 1949, p. 98, and J. Textile Inst. 40 A. 154. 1949.)

1452. Dalglish, J., B.P.598, 964 2/3/1948
Laurie, K. S.
STENTER DRYING MACHINE. The claim is for a stenter provided with air jets for directing hot air on to the fabric from air boxes above and below the travelling web and at least one return flow air duct by the side of the web to collect the spent air after it passes over a heater. Axial flow propeller fans are used.

1453. Dickinson, D. F. Iowa State Coll.J.Sci.1942. 17 51-3
MUSLIN PILE: DRYING.

1454. Eccles, W., Jennings, F. B.P.513,538 of 11/4/1938: 16/10/1939.
and Metropolitan-
Vickers Electrical Co.
Ltd. (London).
CLOTH DRYING APPARATUS. Air for drying paper and cloth is caused to pass a number of times through, over or in contact with the material to be dried and the air is reheated a number of times to the same or substantially the same temperature.

1455. Eyman, C. M. West Gas 8 No.2 Feb. 1932 p.22-3 and 49.
AUTOMATIC DRYER FIRED BY NATURAL GAS SERVES MODERN COTTON GIN. Equipment and practice at cotton gin in Corcoran, California plant of J. G. Boswell & Co; 600 to 1,000 bales of cotton dried per day during 1930 season.

1456. Feil, R. W. Textile Bulletin. 74 No.8 55-57 Aug. 1948
RESEARCH ANALYSES THE TEXTILE DRYING MARKET. Performance and costs of various drying operations on textiles, affording comparisons between hot air, infra-red, and high frequency drying. Conclusion that continuous drying should be stressed at the expense of "package drying". Redesign of the moisture removal systems advised, steam driers are the most economical, infra-red should be considered as a competitor of steam for thin layers, high frequency is only applicable to packaged materials.

1457. Fisch. J.S.D.C. 16, 212 1900 Ost. Woll and Leincn Ind. 1900 11.

DRYING FABRICS IN VACUO.

1458. Fleming, M. T. Amer. Dyes. Rept., 1948, 37, 333-339, 347-348.

TEXTILES: DRYING. The author considers the subject of textile drying under the following headings: (1) Theoretical Consideration (a) basic drying curves, (b) factors affecting drying rates, (c) temperature and humidity, (d) air velocity, (e) method of air application, (f) material factors, (g) special drying applications, (h) infra-red radiation, (i) high frequency drying, (j) methods of obtaining high temperatures, (2) Practical Considerations.

1459. French, C. A. Textile World, 1944, 94, No. 10, 113-115.

DIRECT-FIRED DRYING OVEN: ADVANTAGES. Advantages are claimed for a system of cloth drying in which better direct use is made of the radiant and sensible heat of the fuel. A thermal efficiency of 80-90 per cent. may be reached. A diagram shows a direct-fired drying oven in which the wet cloth passes between radiants and most of the steam and combustion gases are circulated and heated again t a temperature of about 800°F. where the cloth enters. The full ra of evaporation of the water in the cloth is reached within about a foot of travel and the cloth passes on through an inert atmosphere at progressively falling temperatures down to about 210°F., though never down to the dew-point of about 168°F. C.

1460. Funk, W. H. Rayon Textile Monthly, 1947, 28, 90-91.

JACKETED STEEL DRYING ROLLERS: DEVELOPMENT. The advantages of th jacketed type of drying roller are discussed. The welded steel fabrication allows of a wide range in roller design and as the stea is confined to a restricted area, much less than that of a single-shell roller, and is in controlled motion, there is a considerable economy in steam and much less film on the inner surface of the shell plate. Illustration of large cylinders.

1461. Goldman, M. A., Mechanical Engineering, 1941, 63, 609-610

Rappold, H.

DRYING MACHINES. High-pressure hot water is being used with advantage as a source of heat for textile driers. With this syster which is adaptable to most types of drier, water is circulated by means of a centrifugal pump from a point in the boiler below the water level through the equipment to be heated, and back to the boiler. The water is at boiler pressure (generally 50 to 200 lb.pe sq.in.). Losses usual with steam systems are eliminated and fuel costs reduced 20 to 40 per cent. The efficiency of tenter frames can be increased by forcing the hot air at high velocity through the interstices of the cloth. Details of operation are given.

62. Haller, R. Ciba Review 7 2835-6(1949)
DRYING TEXTILES. Stresses the importance of supplying white fabrics to the printer in its proper regain moisture content, to ensure intensity, brilliance and fastness.

63. Hicks, T. G. Text.World 100(2)149 Feb.1950
TEXTILE MACHINERY. STEAM ECONOMY. Faulty operation and remedies.

64. Hewlett, E. Textile Manufacturer 72 194-5 1946
ELECTRIC HEATING DEVICES. APPLICATION TO TEXTILE PROCESS. Continuation of series on the electric driving of textile factories, the author discusses electric heating of machines, calenders, mangles etc., and claims advantages for radiant heating. Industrial electric heating by radiation, conduction, convection or a heat pump system is also discussed.

65. Hunt & Moscrop Ltd. B.P.570,774 24/12/1943
Sharpe, J.
FABRIC DRYING APPARATUS. A machine divided in two parts horizontally to double the effective length. The fabric travelling back below is held up by suction.

66. Hunter, J. Machine Co. U.S.P. 2,252,181 Aug.1941.
ROTARY TENTER DRYING MACHINE. Machine consists of a housing with fresh air inlets and moist air outlets, opposed endless tenter chains carrying the material round a perforated rotating cylinder and means for heating and circulating air repeatedly through the material in an upward radial direction of the cylinder.

67. Irons, M. H. Mech.Eng.g.65 115-8 1943
EVAPORATIVE COOLING SYSTEMS. Design of systems for specified conditions is illustrated by a study of examples.

68. Jones, B. M. Am.Dyestuff Reporter 25 No.17 Aug.24 1936 p.470-2.
LATEST ADVANCES IN PIN TENTER DRYING. Fundamental principles of tenter drying listed; manner in which these principles are applied in modern machine are shown.

69. Jones, E. H. J.Text.Inst.40 907 1949
DRYING OF WARPS AT THE TAPE FRAME. A report of a lecture on possible methods of drying warps at the tape frame, with particular reference to the principles involved in heat transfer and drying on cylinders, more efficient use of which can considerably increase output.

1470. Jones, E. H. Inst.of Fuel.Drying Study March 1951
ACCELERATED CYLINDER DRYING. Factors limiting the drying capacit of a cylinder are discussed, particularly the effect of the layer of stagnant vapour layer shrouding the material. This can be largely eliminated by continuous removal with a stream of air, which is shewn to be as effective when not preheated as when preheated to temperatures as high as or higher than the cylinder temperature. The principle is used in the Shirley accelerated drying device which is described and illustrated. Curves illustrating the results are presented.

1471. King, G. T., and W.C. U.S.P.2,309,961 Feb.1943.
YARN DRYING APPARATUS. A double drum is provided with a hood through which air is drawn.

1472. Laurie, K. S. J.Soc. D.& C.56(7)289-295 July 1940
MODERN TEXTILE FINISHING MACHINERY.

1473. Lister Bros. Ltd. B.P.570,541,11/10/1943
Broad, L. F.
DRYING MACHINE. A drying machine in three parts, each part performing different functions, with respect to temperature and humidity, length of path and tumbling devices.

1474. Lundrigan, R. Textile World 1944,94,70-71; J.Text. Inst.1944,35,A517.
DRYING CYLINDER CONDENSATE HIGH-PRESSURE RETURN SYSTEM: ADVANTAGE Brief particulars are given of some American finishing works in which the problem of providing steam for additional drying plant h been met by the installation of jet or centrifugal pumps and auxiliary gear for returning the condensate from the drying cylinders under high pressure to the boilers. With such plant it is possible to return the condensate from steam supplied at 100 lb per sq. in. (338°F.) at 320°F., thus preventing the usual heavy loss if an open system is used to return water at about 210°F.

1475. Lundy, R. B. Paper Mill News.73,42,61-64,74.1950
INSTRUMENTATION AS AN AID TO PAPER DRYING. The selection and application of instruments are discussed. B.11.204.Feb.51.

1476. Northcroft, L. G. Text.Mnfr.67,60 1941
ROLLER DRYING.

1477. Petrie and McNaught Ltd. Textile Recorder, 1946,64,Dec.,14-45
MULTIFAN YARN DRYING MACHINE. An illustrated description is giver of a modification of a machine for drying loose fibre to the dryin of hanks of hosiery, carpet and ordinary sewing and weaving yarns. The hanks are conveyed through the machine on aluminium alloy poles

The machine is built up in 6 ft. sections of widths 5 to 8 ft. The output ranges from 100 to 2,000 lb. per hour according to the number of sections and the type of yarn.

478. Proctor and Schwarz, Inc. Textile World 98 No.2.149.1948
DRYING AND SHRINKING MACHINE. The wet goods are "over-fed" to the top one of three conveyors, and dried in a swift current of hot air: free shrinkage is obtained.

479. Proctor and Schwarz, Inc. Rayon and Synthetic Textiles,1948,29, No.9,142.
ROLLER DRYER FOR CONTINUOUS VAT DYEING MACHINE. A drying machine use preparatory to reducing on the continuous vat dyeing range has a number of individually driven rollers in its passage over which the fabric is subjected to the action of heated air blown at both sides from air ducts with staggered nozzles.

480. Rabold, C. N. Amer.Dyes.Rept.34,108-16.1945
TEXTILE MATERIALS "DRYING". Recent developments are described, including steam drying, indirect fired dryers, infra-red drying and dielectric heating, and future developments are indicated. Diagrams and photographs of infra-red installations for yarns, fabrics, rugs and carpets are presented and discussed.

481. Rabold, C. N. Textile World,1948,98,No.9.122-123
GAS-FIRED DRYING MACHINES: CONSTRUCTION AND ACTION. The author claims that the most efficient way of drying fabrics is by gas-fired dryers. These burn vaporised oil (completely combustible). A fan sucks air through the burners, onto a series of baffles, and finally onto the cloth on which it impinges with "pulsating velocity". The temperature may be as high as 450°F., and the drying medium is a mixture of inert combustion products and superheated steam; they are returned back into the burning chamber, and re-circulated 24 times a minute. A drawing and photographs are shown.

482. Schulze, R. Warme 55,736-9,(1932)Oct.22.
MODERN CLOTH DRYING MACHINES. Necessity for drying cloth at low temperatures, comparison of dryers of olden designs with modern type with drying in stages, and horizontal air supply, showing advantages of latter.

483. Shoemaker, R. W. Textile World,1948,98,January,125,194-196
HIGH PRESSURE CONDENSATE RETURN SYSTEM: APPLICATION IN FABRIC DRYING
An illustrated description is given of an installation at the mill of the Rhode Island Worsted Co. Water drawn from a constantly filled thermo-fin loop is discharged at high velocity through a jet-pump nozzle. The jet strikes the returned hot condensate and induces condensate flow through a Venturi-shaped mixing tube into the thermo-fin priming tube. The additional volume of condensate introduced

into the loop results in the discharge of an equal volume through the air separator into the boiler. Great economies are claimed.

1484. Slade, F. H. Heating, Piping and Air Conditioning 22 263 545-51 May 1949

SOME TEXTILE PROCESSING PLANT. A general description of processing including a substantial section on driers and on the increased capacity of the steam drying process, No data. Descriptive only.

1485. Slade, F. H. Brit. Rayon and Silk J. 27(314)62-5 July 1950

MODERN FINISHING MACHINERY. TRENDS IN DESIGN OF AIR DRYING PLANT. Illustrations and descriptions of types of hot air dryers. Principles explained.

1486. Speke, R. W. Inst. of Fuel Drying Study March 1951

DRYING AND TEXTILE DYESTUFFS. The two most important aspects are:-
(1) Swealing of dyestuffs of low affinity for the fibre and
(2) The heat sensitivity of the dyed fibres. The author describes the effects of certain variables upon migration (swealing) and by sublimation. Heat sensitivity effects are as follows:-
(a) the dyeing may appear unlevel after drying, (b) bulk materials may become entirely off-shade, if heated for too long. Methods of avoiding these difficulties are indicated.

1487. Spirax Mnfr. Co. Text. Mfr. 67(797) 1941 p.209

STEAM HEATED DRYING CYLINDERS. MODERN METHODS IN DRAINING AND AIR VENTING CANS, CYLINDERS OF SLACKING MACHINES ETC. Bulletin describes an advanced system of draining and air venting textile drying cylinders. Applied to existing machines with little alteration. The spirax system allows each cylinder to discharge freely into the common condensate pipe which is at atmospheric pressure. Diagrams.

1488. Spooner, Dryer & Eng. Co. Ltd. Textile Recorder, 1947, 65, June, 57-58.
(2) Silk J. Rayon World, 1947, 24, July, 42.

VERTICAL DRYING MACHINES. (1) An illustrated account is given of recent models of vertical drying machines, including one for securing a soft finish on towelling, and a two-pass machine fitted with cuttling gear for light fabrics of rayon and silk. (2) A sectional machine for securing a soft finish in rayon and cotton fabrics is described.

1489. Spooner, W. W. J. Soc. Dyers & Col. 55(6) 303-8 June 1939

TEXTILE DRYING MACHINERY. 1. Advantages and Disadvantages of Can Drying. 2. Convection rate in linear proportion to air speed up to 32 ft. sec. and is roughly proportional to temperature. Thus there are two limiting factors, (1) Temperature. (2) 32 ft. sec. air speed. Air currents directed on to cloth. At high speed they remove boundary layers, penetrate cloth and produce a channel of turbulence. The lecturer dealt chiefly with air currents blown at the cloth, and with festoon and other tensionless methods.

Spooner, W. W. Text.Mnfr.72 211-13.1946

DRYING MACHINERY. IMPROVEMENTS. Principles of design for loose materials are discussed. The vertical dryer in festoon with banks of nozzles is most suitable for drying crepes and a 28½% shrinkage has been obtained as against a maximum of 30%. The use for crease resisting finish is discussed. A cloth steamer has been designed with considerable economy of steam.
A washing machine is described where water is projected against the cloth instead of steam.

Suter, A. Melliand,2,No.8,Nov.1930,pp.1080-1083, 4 figs.

DEVELOPMENT OF TENTER DRYING MACHINERY. Disadvantages of older forms of tentering machines; description and advantages of machine made by H. Krantz Soehne, Aachen, in which method of drying cloth in stepwise decreasing temperatures was evolved.

Thiebaut, R. Chaleur & Industrie 18 No.20 Apr.1937 p.165-7

ETUVES ET SECHOIRS DANS L'INDUSTRIE TEXTILE. Driers in textile industry; author reports on improvements made during recent years and gives summary of modern methods and their application; calculations pertaining to operation given.

Thomas, F. W. J.Soc.Dyers & Colourists 65 479-483 1949

DRYING OF TEXTILES. General trends in textile drying are outlined, together with a comparison of relative efficiencies of the various methods from the energy-utilisation standpoint. Cylinders should have automatic air vents, steam should be removed on the cloth side by controlled ventilation, syphon extraction is preferred to bucket scavenging at high speeds. In stenter drying, economy and production rate are improved by controlled ventilation at high speed, improved heat exchanger design and instrumentation for speed control based on the moisture content of the cloth. The merits of infrared and high frequency drying are discussed.

Thomas, F. W. Inst.of Fuel Drying Study March 1951

STEAM CONSUMPTION IN THE CONTINUOUS RECIRCULATORY DRYING OF TEXTILES. Increasing interest is being shewn in the steam consumption of hot air drying machines. Claims by U.S.A. and Continental machinery makers for the efficiency of their latest stenter machines have directed attention to stenters. The paper analyses sources of heat loss and endeavours to establish a reasonable target figure for steam consumption in relation to weight of water evaporated. The results apply to other recirculatory hot air drying machines.

1945. Thomas, P. M. Textile World 99(3) 116-117 1949
TEXTILE DRYING PLANT. COMPARATIVE STUDY. A brief account of a study carried out at the Institute of Textile Technology, Charlottesville, in which various textile drying practices were studied for efficiency and economy, (including vacuum extraction, infra-red and high frequency heating). The main conclusions were: Steam is the cheapest source of heat, steam heated cylinders are th most practical method now used and better designed equipment could improve drying as much as 20%. Summarised findings in eight table

1496. Traoutschold, R. Rayon Textile Monthly 18 Nos. 4 and 5
Apr. 1937 p.259-60 and May p.330-1
CONTROL IN CLOTH AND YARN DRYING. Modern systems effect marked economies; notes on loop and yarn driers, and on vacuum extractors

1497. Vyrypaev, D. A., Promyshlennost Energetika No.8 Aug. 1949
Sheinker, Ya. E., p.12
Shebolov, V. K.
TECHNICAL IMPROVEMENTS IN TENTERING AND DRYING MACHINES FOR CLOTH.

1498. Walker, A. C. Trans. Amer. Soc. Mech. Engrs. 65 329-336
1943 Chem. Abstr. 37 6136 1943
TEXTILE FIBRES. DRYING. Hysteresis effects in textile fibres affected by temperature and rate of drying. Strength and durabili also affected. Wool absorbs less water from 4.5% sulphuric acid solution and more water from alkali soln. than untreated wool. Cabinet dryers yield cotton of uniform quality.
Rayons and purified cotton are sensitive to drying temperatures. High humidity at any temperature is more harmful than low humidity. Carpet wool shews the degrading effect of humidity more than clothing wool.

1499. Walker, A. C. Text. Res. 10 443 461 1940
GENERAL ACCOUNT OF THE PRINCIPLES OF DRYING TEXTILES.

1500. Walker, A. C. Amer. Dyes. Rept. 36 753-6 1947
TEXTILES: DRYING. Recent advances in the study of the mechanism of drying textile materials are described, together with current drying methods. Future developments are indicated and a drawing is shewn of a low temperature dryer. A dryer employing alternate vacuum and atmospheric pressure was claimed to reduce drying times.

1501. Walter, L. Textile Mnfr. 1949 75 228-31, 282-84,
328-331
TEXTILE DRYING MACHINES. AUTOMATIC CONTROL. Automatic Control i discussed in all its aspects, and with special reference to the design of textile drying equipment. The theoretical aspects of drying are discussed in relation to control.

502. Walter, L. Textile Mnfr.1949 75 462-465 534-537
AUTOMATIC TEMPERATURE AND HUMIDITY CONTROLS. APPLICATION IN TEXTILE DRYING. Deals with the control of drying rooms and chambers, drying stoves and heater batteries. See J. Text. Inst. 40 A403, 1949 for theory of control.

503. Weisbach, C. H. Textile Recorder 50, 39-40(1932)Oct.8
BUTHION HOT-AIR SUCTION DRYER. Continuous drying machine for silk, rayon and other piece goods. Drying is effected by passing hot air through fabric while it is fully supported, but without tension.

504. Weisselberg, A. Melliand Textile Ber.4 322-4(1932)Aug.
NEW DEVELOPMENTS IN TEXTILE DRYERS. Distinctively different line of dryers brought out by Buttner, which are claimed to have higher thermal efficiency with lowest power consumption; perfect control over drying result and absolutely uniform drying.

505. Williams, W. E. Textile World 97 133 Oct.1947
NEW HOT AIR SLASHER INSTALLED AT AVONDALE MILLS. Illustrations. Diagrams.

506. Yelland Textile Mnfr.66 p.463.Dec.1941
CONTROL OF WARP MOISTURE CONTENT IN SLASHING.

ir Conditioning

507. Anon. Rayon Textile Monthly, 1942,23,355-357
HOSIERY MILLS: AIR CONDITIONING. The importance of air conditioning in textile mills is discussed and it is pointed out that its importance in hosiery mills has increased with the change from silk and nylon to cotton and rayon hosiery. The relative humidities required for the processing of the various fibres are indicated and air-conditioning installations in American mills are briefly discussed.

508. Caluwe, J. de Textielwesen 4(7)73-82 1948 J.Text.Inst. 40 A.166.1949
AIR CONDITIONING IN COTTON MILLS. Requirements at various stages and methods of conditioning are discussed.

509. Davidson, P. L. Textile World, 1949, 99, No. 3. 141, 198, 200, 202, 204
SPINNING MILL: HUMIDITY AND TEMPERATURE CONTROL. Results of a study on the effect of temperature and humidity on health and comfort are summarised. The conclusions are that (i) the effective temperature in a textile mill should not exceed 80°F. on an 8-hour exposure for maximum efficiency of the worker; and (ii) conditions of 85°F. effective temperature or above will not be injurious to the health of the average worker in good physical condition but could

affect those below par, and will impair the efficiency of the average worker. Methods for maintaining an effective temperature of 80^{0}F. (which is 86^{0}F. dry bulb at 60 per cent. relative humidity) with a straight evaporative-cooling system are considered.
See also this J.97,4,1947. same author.

1510. Dearnaley, A. Textile Mnfr. 1940
AIR CONDITIONING IN TEXTILE MILLS.
(1) pp.137-9 Introduction.
(2) pp.190-1 The effect of Atmospheric Conditions on the efficiency o
spinning and weaving.
(3) pp.232-3 Types of Humidifying plant.
(4) p.272-282 Direct Water Spray Humidification.
(5) p.308 Principles of Automatic Control.
(6) p.341 Estimation of Plant Capacity.
(7) p.382-3 Calculation of requirements.
Abstracts in Jnl. of Textile Inst. 1940.

1511. Herkimer Rayon Text. Mon. 1948 29(3) 94-6(4) 103-4(5) 59-60 B.I.423 June 1949
AIR CONDITIONING IN TEXTILE MILLS. A glossary of terms is given as used in air conditioning. Data for regain of the common textile fibres at 75^{0}F. The need for definite atmospheric conditions for textile processing is discussed and data for R.H. applicable to the electrical and textile processes for various fibres are tabulated. Practical notes are given on the control of regain, drying and conditioning, the humidity control of rate of chemical reactions, elimination of static electricity, and humidification systems.

1512. Mouldin, E. Textile World. 95(117) 184-5 1945
EVAPORATIVE COOLING SYSTEM. ADVANTAGES. An illustration of a combination cooling, ventilating and humidifying system in American cotton mills. Master controls regulate access of outside air. R.H. is controlled by a direct acting humidity control which operates a diaphragm valve in the air line which, by controlling the compressed air flow, governs the operation of the atomisers.

1513. Pollitt, J. J. Text. Inst. 41 P.1-6. 1950 B.II 680 Aug. 1
THE IMPORTANCE OF HUMIDITY IN TEXTILE MANUFACTURE. The strength of nylon, wool, silk and rayon decreases with increasing humidity, that of cotton and flax increases. Friction increases with R.H. above 80%. The importance of humidity regulation with regard to knitting on the physical properties of textiles is pointed out and appropriate R.H's are suggested.

1514. Scientific Air Conditioning Ltd. Textile Recorder, 1948, 6, August, 52-53.
COMPACT AIR-CONDITIONING EQUIPMENT. An illustrated description is given of the air-conditioning plant recently installed at the Adelphi Mills of Fine Spinners and Doublers Ltd., Bollington. It is of

compact construction and designed especially for older mills using steam engines and line-shaft power transmission.

1515. Strong, J. H. Hosiery Times 19(209)46-7 1946
AIR CONDITIONING AND MOISTURE FOR HOSIERY. Hosiery firms opinions regarding R.H. in knitting rooms. The influence of moisture on the working of various fabrics.

Fundamental Principles

1516. ——
MOISTURE RELATIONS OF TEXTILES. See under General Principles.
Orme Masson
W. A. Davis
F. T. Trouton
M. W. Travers
E. H. Fisher

1518. Anon. Boll. Cotoniera, 1940. 35, 337-339
through Brit. Abstr. 1948, B. 11, 526
TEXTILE FIBRES: STRENGTH AND STRETCH; INFLUENCE OF HUMIDITY. Data are tabulated for the strength and stretch values measured at 0-100 per cent. relative humidity on wool, hair, silk, cotton, jute, flax, paper fibres, hemp, ramie, kapok, and rayons (staple fibres, cuprammonium, viscose, and acetate). Stretch increased with increase in R.H., except for jute where a maximum at 80 per cent. R.H. is followed by a slight fall. Maximum and minimum per cent. increases at 100 per cent. R.H. are 325.5 with hair and 1.3 per cent. with jute. Strength decreases with increase in R.H. for wool, hair, and silk and all the rayon fibres. With jute and paper fibres there is an increase to a maximum at 80 and 70 per cent. R.H., respectively, and then a sharp fall. The other fibres all show a progressive increase in strength with R.H. the effects observed depend to some extent on the treatment the fibre has undergone.

1519. —— Silk J. Rayon World 21 35 37 42 21 July 1945
TEXTILE FIBRES: MOISTURE RELATIONS. A useful summary of the knowledge on the moisture regain of fibres, its variation with atmospheric conditions and its influence on physical properties.

1520. Andrews, B. R. Textile Research 8 231-6 1937-8
TEMPERATURES IN DRYING. Their effect on cost of operation and wear resistance of textiles. Fast dried goods have a greater wear resistance.

1521. Barker & Lewis J. Textile Inst. (1924) T.453
EQUILIBRIUM MOISTURE. Thermodynamic effect of moisture regain.

1522. Barker, S. G. — Trans. Inst. Chem. Eng. 6, p. 162-167, 6/12/1928

THE HYGROSCOPIC NATURE OF TEXTILE FABRICS. The moisture relations of various textiles (including artificial) are dealt with.

1523. Baroni, A. — Gazzetta, 1939, 69 435-443 through Brit. Chem. Abs. A. III, 1939, p. 1007

WATER OF CONSTITUTION AND OF HYDRATION OF ANIMAL AND VEGETABLE TEXTILE FIBRES. Curves showing the heat of hydration plotted against the water content of the fibre have been obtained for several vegetable and animal fibres (cotton, rayon, wool, silk). The curves for the vegetable fibres are continuous, whereas those for silk and wool show marked discontinuities at 1.5 and 2 per cent. of water, respectively, in the fibre. This indicates the existence of two kinds of water in the animal fibres, viz., water of constitution and water of hydration. Similar conclusions are obtained from measurements of the aqueous vapour pressure of the fibres at 50°.

1524. Bartell, F. E., Purcell, W. R. Dodd, C. G. — Discuss. Farad. Soc. 257-64. 1948 Chem. Abstr. 43, 3623, 1949

THE MEASUREMENT OF PORE SIZE AND OF THE WATER REPELLENCY OF TIGHTLY WOVEN TEXTILES. Pressure displacement method with fluid at zero contact angle. Radii of 6 to 100 mu are measured.

1525. Baxter, S., Cassie, A. B. D. — Trans. Farad. Soc. 37, 517-25 1941

TEXTILES: PROPAGATION OF TEMPERATURE CHANGES IN HUMID ATMOSPHERES. Rates of propagation of temperature changes through various Textile fibres have been determined. Time for given charge is found to depend directly on the steepness of the regain curve. Two groups are apparent:-

1. Slow rate, - Kapok, wool, casein, viscose rayon.
2. Faster rate, - cotton, silk, cellulose acetate rayon, and flax.

1526. Baxter, S. — Proc. Phys. Soc. 58, 105, 1946

THE THERMAL CONDUCTIVITY OF TEXTILES. Measurements of the conductivity of wool felts ranging in density from 0.1 to 1.0 gms/c.c. have been made using Hèrous and Laby's method for determ'n. of air conductivity. The conductivity of horn has been measured by the Lees disc method, and it is suggested that wool and horn have identical conductivities. Data are used to obtain an empirical relation between thermal conductivity and bulk density.

1527. Bobeth, W. — Klepsig's Textil. Z. 44, 975-982 Chem. Abstr. 38, 2212, 1944

FIBRES MOISTURE ABSORPTION. Experimental work is described and results are given for average moisture absorption at 65% R.H. for various fibres. These values are recommended to take the place of standard regains in quantitative analysis.

1528. Buck, L. Rayon Textile Monthly 17 No. 8 Aug. 1936 p. 523-4 and 550

MECHANISM OF DRYING TEXTILE FIBERS AND FABRICS. Factors to be considered in drying textile fibers; forms in which moisture or water is present; significance of wet and dry bulb temperature and physical laws governing adiabatic evaporation of moisture, as encountered in atmospheric driers, and effect of drying conditions on final product discussed. Bibliography.

1529. Carlene, P. W. J. Soc. Dyers & Col. 60, 232-7, Sept. 1944

THE MOISTURE RELATIONS OF TEXTILES. A Survey of the Literature on the absorption and desorption of water by cotton, rayon, wool, silk, jute, and the influence of moisture on the electric properties, swelling and rigidity of fibres, and the effects of processing on the absorbency of fibres. See also American Dyestuff Rep. 34, 322-7, 1945.

1530. Cassie, A. B. D. J. Text Inst. 31, T17-T30 1940

Textiles: Moisture regain and humid atmosphere changes.

1531. Cassie, A. B. D. Phys. Soc. Repts. on Progress in Physics 10, p. 141-170, 1946

PHYSICS AND TEXTILES. Physical characteristics of clothing material Thermal properties of textiles. Equilibrium moisture relations. The swelling of wool and its water absorption. Analysis of wool-water isotherms Diffusion in Keratin. Water repellency in textiles. Large bibliography.

1532. Cassie, A. B. D. Discuss. Farad Soc. No. 3 239-242 1948

PERMEABILITY TO WATER AND WATER VAPOUR OF TEXTILES AND OTHER FIBROUS MATERIALS.

1533. Cassie, A. B. D. Trans. Faraday Soc., 1944, 40, 546-551
Baxter, S.

POROUS SURFACES: WETTABILITY. The analysis of apparent contact angles for rough surfaces is extended to porous surfaces, particularly those encountered in natural and artificial clothing. Formulae are derived for the apparent contact angles, and experimental data confirming the formulae are given. Water-repellent clothing structures are studied by means of this analysis, and it is shown that the water-repellency of the duck is due to the structure of its feathers rather than to any exceptional proofing agent.

1534. Collins, G. E. Shirley Inst. Mem. 21, 9, 69, 1930, J. Text, Inst. 21, 314, 1930

THE SWELLING OF COTTON HAIRS IN WATER AND AIR AT VARIOUS R.H.S. A close relationship was found between the extent of dimensional changes and the amount of absorption between 20° and 100°C.

1535. Daniels, H. E. Trans. Farad. Soc. 37, 506-517 1941
TEXTILES: PROPAGATION OF TEMPERATURE CHARGES IN HUMID ATMOSPHERES. The theory of heat and water vapour transfer through textiles is given when both diffusion and air transport are considered, and the shape of the curves obtained by King, Cassie & Baxter is explained. A method is given for estimating the speeds of fast and slow components by areas without detailed fitting of theoretical curves.

1536. Darling, R. C., Belding, H. S. Ind. Eng. Chem. 38, 5, 524-529, 1946
MOISTURE ADSORPTION OF TEXTILE YARNS AT LOW TEMPERATURE. Measured for various Textiles at + 40°. 0° and - 20° F and at several R.H.S. above 50%. The bound water is found to be less at low and at high temperatures, and its significance in terms of heat of adsorption is discussed, curves and mathematical analysis.

1537. Davis, W. A., Vargas Eyre, J. Proc. Roy. Soc. A 104, p. 512, 537
(Linen R. A.) 1923
THE DISCONTINUITY OF THE HYDRATION PROCESS. Tables of results, curves and analysis of the hydration of

Flax
Ramie
Cotton wool
Gelatin
Anhydrite
Copper Sulphate

1538. Dicker, R. Rayonne, 1948, 4. No. 10., 39-51: No. 11.
89-97: No. 12. 109-115: 1949, 5. No. 1, 39-45;
No. 2, 57-61; No. 3, 81-87. (In French)
TEXTILE DRYING PLANT: GENERAL PRINCIPLES. Physical principles governing rational drying are considered and it is shown by means of examples why a textile material should not be dried to a point below its critical moisture content. Drying by means of hot air is considered with special reference to the part played by the structure of textile fibres, rayon fibres in particular, in the mechanism of evaporation. The phenomenon of solvent-solute migration is described, and different methods of drying, namely: (i) by conduction, (ii) by convection, (iii) by radiation, (iv) by dielectric loss, and (v) under vacuum are reviewed and discussed. An account is given of the control of the moisture content of yarns or fabrics during drying by means of the Fielden Drimeter.

1540. Farrow, F. D., Swan, E. Trans. Text. Inst. 14, 465, 1923, 17, 527, 1926
THE ABSORPTION OF WATER BY DRIED FILMS OF BOILED STARCH. The bearing of experimental results on the drying of sized warps is indicated.

1541. Fleming, Myron T. Textile J. Australia 23, 1014, 1032, 1949
FUNDAMENTALS OF TEXTILE DRYING.

1542. Fourt, L. and J. Textile Res., 1947, 17, 256-263
Harris, Milton
CLOTHING FABRICS: PERMEATION BY WATER VAPOUR. One factor influencing the suitability of fabrics for clothing is their resistance to the passage of water vapour. Measurement of the low resistance of woven fabrics requires a different technique from that for the high resistances of waterproofing and packaging materials, since the resistances are close to that of air itself, which may be used as a convenient comparison standard. Diffusion measurements by the absorption cup method and by the evaporation procedure showed little difference over a wide range of woven and knitted fabrics.

1543. Fourt, L. et. al. J. Text. Res. 21, (1) 26-33, Jan. 1951
DRYING RATE OF FABRICS. Discussion of Drying Rates and their dependence on absorption capacity of the fibre and the thickness of air film.

1544. Gregory, J. J. Textile Inst. 1930 21, T. 66 p. 781
Shirley Inst. Mem. 8, 136, 1929
THE TRANSFER OF MOISTURE THROUGH TEXTILES.

1545. Guthrie, J. C. and also
Howard, W.
SORPTION OF WATER. See under Sorption.

1546. Haas, H. Mell. Textil. berichte 18, 912, 1937
DRYING. PROLONGED v.s. RAPID DRYING. The author's researches reveal that textiles may be seriously injured by prolonged time of drying. Relation of this to drying process is discussed.

1547. Hartshorne, W. D. Tr. Amer. Soc. Mech. Engrs. 39, 1073-1125, 1917
THE MOISTURE CONTENT OF TEXTILES AND SOME OF ITS EFFECTS. Results of experimental work on the moisture relations, of various textiles. Results are embodied in tables and curves. Discussion 1145-1170.

1548. Henry, P. S. H.
Discussions Faraday Soc.243-57,1948
cf.Chem.Abstr.34,3560 1934, and
3623,1949

THE DIFFUSION OF MOISTURE AND HEAT THROUGH TEXTILES. 2 coupled diffusion processes. Nomograms are provided to simplify. Numerical treatment, and the theory applied to compressed cotton fibres over a range of temperatures and humidities.

1549. Hermans, P. H., and
Vermaas, D.
Kolloid-Z.,1944,109,5-9(through Chem.
Abstr.,1947,41,3291^{g})

CELLULOSE FILAMENTS: VELOCITY OF PENETRATION BY WATER AND GLYCEROL. The absorption of water by dry cellulose filaments can be observed easily by optical means. After a time a sharply defined line can be detected along the periphery of the filament; this indicates the distance penetrated by the water. In absolute dry cellulose, water penetrates very slowly. In cellulose which contains some moisture, the diffusion velocity increases with the fourth or fifth power of the equilibrium moisture in the filament. With filaments containing less than 15 per cent. of water, a temperature coefficient of 2.4, similar to that of a chemical reaction, is obtained. This indicates the possibility of chemica reaction of the water with the cellulose. Glycerol penetrates the cellulose filament only when the latter is in equilibrium with a relative humidity of at least 40 per cent. Dry cellulose is impenetrable to indifferent liquids. The phenomena are analogous to the diffusion of water into certain zeolites.

1550. King, G.
Proc.3rd Textile Teachers Conference
April 1945,16-22

HUMIDITY - ARTIFICIAL CONTROL. Factors controlling rate of conditioning or change of regain when textiles are brought into changed atmosphere. Plant for shed humidification is described and for drying and for testing room humidity control.

1551. King, G.
J.Soc.Dyers & Col.66,(1)pp.27-33
Jan.1950

THE SWELLING OF TEXTILE MATERIALS. Outlines the present state of knowledge of the swelling of fibres and keratin on absorption of water, organic acids and solvents. The difference between the early stage and later stage of adsorption regarding rates of swelling, dielectric constants, D.C. conductivity. Hystereris anomolies are discussed, and the danger of assuming equilibrium conditions at very slow rates of adsorption are pointed out. 20 References.

1552. King, G. Wool Inds. R. A. Ann. Rev. of Textile Progress March 1951 D. S. I. R. 6226/C

PHYSICS OF WOOL AND SILK.

(1) Wetting of Textile Fabrics.
(2) Thermal Properties.
(3) Sorption Phenomena.

1553. 1. King & Cassie
2. Cassie
3. Baxter

Trans. Farad. Soc. 1940 36, 445-453, 458-465

TEXTILES. PROPAGATION OF TEMPERATURE CHANGES IN HUMID ATMOSPHERES.

1. Rate of absorption of water vapour by wool fibres.
2. Theory of propagation of temperature change.
3. Experimental verification of above theory. The theory is verified for wool and cotton. See also J. Text Inst. 31, A266, 1940

1554. Koch, H. Schweiz. Arch. Angew. Wiss. Tech., 1946, 12, 176-184 (through Brit. Abstr., 1946, B II, 369

TEXTILE FIBRES: MOISTURE RELATIONS. A formula based on the method of least squares, is derived, giving an approximate relation between the water content and the relative humidity (25 to 98 per cent.) of crude and bleached cotton, rayons and casein powder at 16 to 18°C. during absorption and desorption. The accuracy over this range is adequate for most technical purposes, the calculated values being greater than the observed absorption and desorption values, respectively, by 0.22 per cent. and 0.28 per cent. for cotton, 0.41 per cent. and 0.42 per cent for cuprammonium rayon, and 0.41 per cent. and 0.41 per cent. for viscose rayon.

1555. Lloyd, A. O. Porrits and Spencer Ltd. Nature 157, 735, 1946

EFFECT OF HEAT ON WOOL, COTTON AND NYLON. Examination of aqueous extracts indicates deterioration of textile fibres exposed to high temperatures during use. Table and graphs of data obtained.

1556. Magne, F. C., Portas, H. J. and Wakeham, H. J. Amer. Chem. Soc. 1947, 69, 1896-1902

MOISTURE IN TEXTILE FIBRES: CALORIMETRIC INVESTIGATION. A calorimetric technique employing the method of mixtures has been applied in a study of the nature of moisture in textile fibres. Measurements were made on native cotton, mercerised cotton, cellulosic rayon, nylon, and glass fibres with various moisture contents. The amounts of freezing and non-freezing water were calculated for each fibre/moisture combination measured.

Interpretation of the result. for cellulose fibres permits differentiation between water of primary adsorption and water adsorped in multilayer formation or by capillary condensation. From the data obtained estimates of the degree of crystallinity and capillary volumes with certain limiting radii were made for the cotton and rayon fibres. There are 37 references to the literature.

1557. Masson, O. and Proc. Roy. Soc. (London). 412-29 (1906)
Richards, E. S. June 25
ON THE HYGROSCOPIC ACTION OF COTTON.

1558. Neale, S. M., Trans. Text. Inst. and J. 20, 21, 22,
Brownsett, T., Farrow, F. D. 1929-1931
THE SWELLING OF CELLULOSE AND ITS AFFINITY RELATIONS WITH AQUEOUS SOLUTIONS. Parts 1 to 5.

1559. Neale, S. M., Stringfellow, W. A. Trans. Farad. Soc. 37, 525-532, 1941
THE PRIMARY SORPTION OF WATER BY COTTON. Experimental work on the sorption up to 1.5 m.g. per gram. The differential heat of sorption is constant over this range and is 15.7 K. cal. per g. mole.

1560. Peirce, F. T., Rees, W. H., Shirley Inst. Mem. 19, 5, 51, 1944 J. Text
Ogden, R. W. Inst. 36, T. 169-176, 1945
TEXTILE FABRICS. WATER VAPOUR PERMEABILITY. A volumetric method is described for measurement of transfer of water vapour through a fabric. When comparing wax treated materials, it is concluded that diffusion occurs not only through the interstices but also through the fibres themselves. Tests on a number of fabrics are given.

1561. Peirce, F. T., Mann, Shirley Inst. Mem. 3, 1924 to 9, 1930.
Clayton, Brown Trans. Text. Inst. 15, 1924 to 20, 1929 and
J. Text. Inst. 21, 1930
THE INFLUENCE OF HUMIDITY ON THE ELASTIC PROPERTIES OF COTTON. Parts 1 to 5. The variations in physical properties as affected by humidity are discussed in successive parts.

1562. Preston, J. M. and J. Soc. Dyers & Col., 1946, 62, 242,
Chen, J. C. 361-364, 364-368.
TEXTILES: DRYING AND HEATING. I. Moisture in Fabrics. The importance of the critical moisture content and the criteris of the saturation condition are discussed. A continuous record of the weight and temperature of the sample was obtained by means of an Oden-Keen auto-matic balance, using infra-red heating, and a copper-constantan coupl Typical results are presented. Fabrics show two steady temperatures during drying. The lower occurs during the period of the constant dryin

rate; the higher occurs when the fabrics are dry. The rise from the lower to the higher temperature occurs at the critical moisture content. Critical moisture contents and saturation regains are, respectively, wool 39, and 32-41, viscose rayon 38 and 33-46, silk 27 and 33, cotton 26 and 17.5-22.6, asbestos 7 and more than 3.5, and glass 6 gm. water per 100 gm. dry fibre. There are 35 references to the literature. II Use of Infra-red Radiation. Factors affecting the absorption of infra-red radiation have been investigated. Fabrics absorb considerably less energy when dry than when wet. The lower temperature radiation was much more strongly absorbed than that of higher temperature, both for wet and dry fabrics. Low-temperature radiation is more efficiently used and has the further advantage that the presence of dyes makes no difference to the absorption. The values for the absorptions of the fabrics under the different conditions give a measure of the efficiency of the heat transfer at the fabric surface.

1563. Preston, J. M., Chen, J. C. J. Soc. Dyers & Colorists, 64, 60-64, 1948

SOME ASPECTS OF THE DRYING AND HEATING OF TEXTILES. PART 3. THE MIGRATION OF SOLVENTS AND SOLUTES DURING DRYING. The mechanism of moisture transfer has been investigated in the drying of textiles by conduction, convection, radiation and dielectric loss heating, by studying the transfer both of water (and other liquids) and of solutes. With the exception of very slow drying at room temperature and high-frequency drying, all these drying techniques give rise to marked migration of solute. This shows that the solvent moves as a liquid towards the source of drying energy. When the liquid approaches the free surface where the energy enters the fabric it becomes vaporised, deposits the solute and leaves the surface fibres dry. Further liquid is then attracted to the dry surface fibres by capillary action, and liquid from the inside of the fabric feeds the surface layer under a liquid concentration gradient set up by the evaporation of liquid near the surface. Photographs showing dye migration are included to support these theories.

1564. Preston, J. M., Nimkar, M. V., Gundavda, S. P. J. Text. Inst. 42, (2) T. 79-90 Feb. 1951

CAPILLARY AND IMBIBED WATER IN ASSEMBLIES OF MOIST FIBRES. The ways in which moisture is held in order of diminishing firmness of attachment are:-

1. Hydrates of the fibre molecules.
2. Solution of non-crystalline molecules.
3. Capillary water in spaces and surface serrations.

The paper presents the results of an experimental investigation into these aspects.

1565. Razous, P. , J. Amer. Chem. Soc. Aug. 1947
THEORIE ET PRATIQUE DU SECHAGE INDUSTRIEL.

1566. Rees, W. H. Shirley, Inst. Mem. 19, 4, 47, 1944, J. Text. Inst. 36, 165. T. 1945
SOME EXPERIMENTS ON THE EVAPORATION OF WATER FROM A PLANE SURFACE. Using a special apparatus, an investigation was made of the effect of single and double layers of cotton fabrics on the rate of evaporation of water from a moist surface in contact. Relation to release of perspiration.

1567. Rees, W. H. Shirley Inst. Mem. 21, (21) 333, 1947. J. Text. Inst. 39, 351-367, T. 1948
CELLULOSIC TEXTILES: HEAT OF ABSORPTION OF WATER. A method is described for measuring the heat of wetting of textiles, from which data the heat of absorption may be derived. Results obtained for heat of wetting and heat of absorption are given for cotton, mercerised cotton and certain rayons conditioned on the absorption route, and the conclusion is drawn that the heat of absorption of cellulose at zero moisture regain is 283 calories per gram of liquid water (15.6 kilocalories per mole of water vapour). Heat of absorption may be calculated from moisture absorption data by the use of a modified form of the Clausius-Clapeyron equation. An example of this application is given, and it is shown that this method can provide only approximate values of heat of absorption. Finally, the thermostatic action of hygroscopic textile materials on the human body is discussed, and an idea of the considerable magnitude of this effect is given by examples calculated from the heat of absorption data.

1568. Riso Boll. Cotoniera, 1940 35, 117-120
HUMIDITY OF TEXTILE SAMPLES. Ambiguities which may arise from different methods of expressing moisture content.

1569. Rowen, J. W., Blaine, R. L. Ind. Eng. Chem. 39, 1659-63, 1947
SORPTION OF NITROGEN AND WATER VAPOUR ON TEXTILE FIBRES. Measurements were made of the adsorption of nitrogen and water-vapour in six purified textile fibres and titanium dioxide. All fibres had low capacity for nitrogen as compared with water vapour. Surface adsorption were the same for wool, cotton silk and rayon, but differed for the two synthetic polymers, nylon and acetate rayon. 32 References.

1570. Signer, R., Roth, M. Makromol, Chem. 3, 281-5 1949 Chem. Abstr. 44, (5) 2248, 1950
Univ. Bern
METHOD FOR MEASURING WATER EVAPORATION THROUGH DIFFERENT TEXTILE FIBRES. The method is to evaporate from a wick at known temperatures and R.H.s. with one end immersed in a known weight of water. Comparative rates of evaporation for various materials are given.

The rate is not dependent on the water absorption property of the material, as these were in very widely differing ratios. Glass fibres were included in the tests. These had a high rate of evaporation but very small absorption figure.

1571. Skinkle, J. H. and Amer. Dyestuff Rep., 1947, 36, 245.
Moreau, A. J. 5 May, 1947
THE APERMETER - NEW AIR PERMEABILITY DETERMINATION APPARATUS.
A simple apparatus for measuring air permeability of fabrics is described. The time taken by a given volume of air to flow through the fabric, clamped between metal plates perforated by a hole 3/8 in. diameter, is measured and expressed as a ratio to the time taken for the same volume of air to flow through the apparatus under the same conditions but without the fabric in position.

1572. Speakman, J. B., Chamberlain, N. H. J. Text. Inst. 21, T. 29 1930
THE THERMAL CONDUCTIVITY OF TEXTILE MATERIALS.

1573. Speakman, J. B. J. Text Inst. 27, T185, 1936
EQUILIBRIUM MOISTURE CONTENTS.

1574. Toner, Bowen & Whitwell Text Res. Jnl. 1947 17, 7-18
DATA ON MOISTURE RELATIONS. Available data compared with their statistical correlation of moisture equilibrium data based on an Othmer chart in which lines of constant regain are plotted on a chart of the v.pr. of water over the yarn, to the v.pr. of water at the same temperature.

1575. Urquhart, A. R. Shirley Inst. Mem. 8, 27, 1929, Tr. Text. Inst. 20, 125, 1929
THE MECHANISM OF WATER ABSORPTION BY COTTON. The behaviour observed is in accordance with that of an elastic gel.

1576. Urquhart, A. R., Shirley Inst. Memoirs 1924 to 1932.
Williams, A. M., Vols. 4 to 11, Trans. Textile Inst. 15,
Eckersall, N., Bostock, W. 1924, 16, 1925, 17, 1926, 18, 1927, J. Text. Inst. 21, 1930, 23, 1932
THE MOISTURE RELATIONS OF COTTON. Parts 1 to 8. A study of the various factors influencing the moisture absorption of cotton. Previous work on the taking up of water is reviewed in Part 1.

1577. Walker, A. C. Amer. Dyestuffs Reporter 29, (9) 217-219
29 Apr. 1940
SCIENTIFIC APPROACH TO TEXTILE PROBLEMS. The prime necessity for moisture relation data is emphasised. These have been ascertained for several textiles and tables are to be published later. Effect of humidity and temperature on textiles (degradation) is being investigated by Wiegerink.

1578. Walker, A. C. Textile Research 13, 5, 15-35, March 1943
THE DRYING OF TEXTILES. Drying research objectives:- The evaluation of the effects of temperature and humidity on the physical and chemical properties of textiles fibres. Discussion of moisture relations data. Hysteresis effects. Combined effects of heat and humidity during drying. Finishing and scouring agents. Package drying of cotton and effect of temperature on drying rate. Theory of moisture distribution in textile fibres. See also Trans. Amer. Soc. Mech. Eng. 65, 39, 1943.

1579. Warburton, F. L. Text. Inst. Lecture Aug. 1950
Wool Inds. R.A. D.S.I.R./3766/C.
AIR PERMEABILITY AS A MEASURE OF FIBRE SURFACE. An account of the mechanics of flow of fluids through granular beds and the application to the textile field. The application of air flow methods to textile problems, such as the measurement of fibre swelling.

1580. Whitwell and Toner Text. Res. Jnl. 1947 17, 99-108
MOISTURE RELATIONS. Shews how the relation:- regain - v.p. over solid - v.p. of air at same temperature could be used to extrapolate experimental data and obtain an entire family of equilibrium curves from a minimum of experimental data. See also this Jnl. 16, 255-67, 1946.

1581. Whitwell, J. C., Willmer, D. B. Text Res. J. 17, 664-9, 1947 B II
Nov. 1948, 526
CALCULATION OF EQUILIBRIUM MOISTURE RELATIONS (OF FIBRES), WITH PARTICULAR REFERENCE TO LOW TEMPERATURE CONDITIONS. Freezing and non freezing water content. Data for 0-43°F. isotherms for various fibres. Freezing water is assumed to be negligible.

1582. Wiegerink, J. G. Text. Res. 10, 9, 357-371, 1940
THE MOISTURE RELATIONS OF TEXTILE FIBRES AT ELEVATED TEMPERATURES. Results are given in the form of graphs shewing moisture content against R.H. for various fibres. The linear relations up to 200°F change from there to 220°F.

1583. Wiegerink, J. G. Textile Research 10, 12, 493-509,
Oct. 1940
THE EFFECTS OF DRYING CONDITIONS ON THE PROPERTIES OF TEXTILE YARNS. The breaking strength and elongation of 9 yarns of various fibres, were determined, drying under various conditions. The quality was found to have deteriorated after heating for 6 hours at 221°F. See also Wiegerink, this J. 10, 8, 334-340, 1940.

1584. Wiegerink, J. G. J. Res. Nat. Bur. Stds. 24, (a) 693-644
(b) 645-664 1940
YARNS: MOISTURE RELATIONS AT HIGH TEMPERATURES. Various yarns were tested at various R.H.s. from 96°F to 302°F. The results

were embodied in graphs.
(a) Equipment for conditioning.
(b) Moisture relations at elevated temperatures 96-302°F, at R.H.S. 5-90%. See also J. Soc. D & C. 56, (10) 443 & 450, and J. Text. Res. 10, 357, 1940.

1585. Winston, G., Backer, S. A.S.T.M.B-1,Cttee.D-13,June 1948
MEASUREMENT OF THE THERMAL TRANSMISSION OF TEXTILE FABRICS.

Moisture Determination and Control

1586. Anon. Textile Weekly,1939,24,745-748
SHIRLEY MOISTURE METER. The Shirley Moisture Meter comprises an electrode system for measuring the electrical resistance of a sample of cotton and an indicating system which indicates the moisture regain of the sample directly. The electrode system consists of a cylindrical stainless steel core surrounded by ebonite and enclosed in a nickel sheath. It is pressed on to a sample with a force of about 45 lb. weight. A mechanical constant pressure device has been designed in order to relieve the fatigue to a routine tester. The electrical resistance measured is that of the cotton bridging the gap between the inner core and the outer sheath of the electrode system. An amplifying valve is employed to build up the current and make possible the use of Record "Cirscale" indicators which have easily read circular scales and give accurate readings over clearly marked dials. The apparatus is portable and may be worked from any ordinary A.C. electrical supply. It can be used for measurements on raw cotton and on grey cotton yarns in any form of package over a range from 4.5 to 15 per cent. regain.

1587. ---- Sci.Libr.Bibl.Series No.570,1937-1941
MOISTURE IN TEXTILES, ESPECIALLY ITS TESTING 21 References.

1589. Balls, W. L. Nature 130,935-8,1932
CAPACITANCE, HYGROSCOPICITY AND SOME OF ITS APPLICATIONS. The method described for determining the water content of cotton bales may be of interest as to possible application to coal.

1590. Chamberlain, N. H. Textile Mfr.71,163-6,173,1945
CLOTH DRYING MACHINERY. The principles of electronic control, through a humidity responsive element, of cloth drying machinery are explained with aid of diagrams and circuits.

1591. Chamberlain, N. H. J.Text.Inst.37,P.249-262 1946
DRYING MACHINE ELECTRONIC CONTROL DEVICE. The fitting arrangemen are transferred to the winding of a single rheostat. The relatic
$I/S = A \log W - B$ must be satisfied at all times.
S = cloth speed.
A = constant, characteristic of the particular dryer.
B = A constant depending upon the output moisture desired.
W = the moisture content of cloth at a specified point.
The detector circuit and control mechanism are described.

1592. Dalglish, Mary; Cook, Margaret C. B.P.567,259 1/10/1942
Dalglish, J., Laurie, K. S.
ELECTRICALLY CONTROLLED FABRIC DRYING MACHINE. An apparatus with suitable relays indicating the moisture content of the fabric and indicating the drying mechanism.

1593. Dietert, Harry W. Co. Rayon Textile Monthly,1946,27,623
FABRIC MOISTURE REGAIN TESTING DEVICE. A moisture "teller" for fabrics, Model 271-T, is described which forces through the sample warm air regulated by a thermo-regulator to temperatures from 140° to 240°F. The apparatus is fully enclosed to avoid fire hazard. Most samples can be dried out in about 60 seconds. The sample pan has a 500-mesh Monel metal filter at the bottom and 100-mesh cover to avoid loss of material during drying.

1594. Fielden Electronics Ltd. Wireless World,55,(1)6,Jan.1940
FIELDEN DRYMETER. Manual on automatic operation for any textile. The instrument enables a 10-15% increase in production. Warp yar is dipped in a size of starch and fat to make it stand up to shocks, strains etc. Yarn mildews in storage if moisture is above 9%. Thumb and finger method of testing is now superceded.

1595. Fielden Electronics Ltd. Silk J.and Rayon World,1947,24,July,44
via J.Text.Inst.,1947,38,A425,
October,1947
FIELD ELECTRONIC HYGROMETER. A device is described for the continuous determination of the moisture content of finished fabri by measurement of the dielectric constant.

1596. Fielden Electronics Ltd. Electronic Engng.1949,21,10-12
DRIMETER AUTOMATIC MOISTURE CONTROL EQUIPMENT. The "Drimeter" automatic moisture control equipment for use in the drying of textile materials operates by making a continuous measurement of the dielectric constant of the material. An illustrated description of the equipment is given with particular reference to the electronic control circuit.

1597. Keating, J. F. and Scott, W. M. Amer. Dyes. Rept., 1942, 31, 308-310

COTTON MATERIALS: VOLUMETRIC DETERMINATION OF MOISTURE CONTENT. A report is given of a study of the application to the determination of the moisture regain of textiles of the volumetric method which depends on cold extraction with methanol and subsequent titration of the water with Karl Fischer reagent (a mixture of iodine, sulphur dioxide and pyridine in methanol). Details of the procedure and of the preparation and stability of the reagent are given. In tests on a bleached, unfinished cotton twill and a bleached, unfinished broadcloth, the titration method gave a higher average per cent. regain than the oven-drying method (0.34 per cent. higher for the twill and 0.36 per cent. higher for the broadcloth). The oven-drying results showed an average deviation from the mean of 0.04 per cent. with a maximum deviation of 0.06 per cent., whereas the titration results showed an average deviation from the mean of only 0.02 per cent. and a maximum deviation of only 0.04 per cent.

1598. MacMillan, J. B. Textile Weekly 44, 1494-98, 1949

DRYTESTER. FABRIC MOISTURE CONTENT MEASURING INSTRUMENT. A moisture indicator for fabric coming from the drying machine depends upon the relation between moisture content and electrostatic potential developed in the fibre by friction. An electrode spanning the width of the fabric picks up the change and transfers it to a vibrating condenser. An indicator shews "too moist" or "too dry" within a 0.5% range of moisture content.

1599. Mitchell, J. Ind. Eng. Chem. 12, 390-1, 1940

DETERMINATION OF MOISTURE IN CELLULOSE. Depends on extraction with methanol and titration with Fischer reagent.

1600. Platzman, P. M. Textile Industries, 1949, 113, No. 2, 149, 151, 153-154

TENTERED FABRICS: "DRIMETER" CONTROL OF MOISTURE CONTENT. An account is given for the advantages gained in a New Jersey bleachery by installing "Drimeter" automatic moisture control equipment. The operation of the Drimeter is described and illustrated.

1601. Spencer-Smith, J. L., Matthew, J. A. J. Text. Inst. 27, 219. T. 1936

A RAPID METHOD OF MEASURING THE MOISTURE CONTENT OF TEXTILES. The method is by measuring the R.H. of the air in equilibrium with a hank of material. Wet and dry thermocouples are preferable.

1602. Spooner, W. W. B.P. 590,742 of 2/3/1945: 28/7/1947

DRYING MACHINE CONTROLLING APPARATUS. A method for measuring or controlling the moisture content of a moving web of paper or cloth leaving a drying machine (especially a cloth stenter) consists in bringing a stream of air at a predetermined temperature and moisture content through a hood into contact with the web and from there to a temperature-sensitive element that gives an indication of moisture content or operates control mechanism.

1603. Stanhope, L. Textile Recorder, 1942, 60, Sept., 41-46
TEXTILE MATERIALS: MOISTURE CONTENT TITRATION. The use of the Fischer reagent for the determination of moisture is discussed. The preparation of the reagent is described and the method of use recommended by Mitchell for the determination of moisture in fibrous materials such as cotton, paper or regenerated cellulose rayon is outlined. The work of Keating and Scott is discussed and essential features of the potentiometric method of determining the end point proposed by Almy, Griffin and Wilcox are noted.

1604. Stierlin, H. Textil-Rundschau, 1946, 1, 163-169
TEXTILES: MOISTURE TESTING BY ELECTRICAL RESISTANCE. A review is given of the electrical principles involved in recent methods, based on resistance measurements, for determining the moisture regain of textile materials. The headings are (1) Measurement of the specific resistance of a fabric at different moisture contents (data are given for a 70/30 wool/viscose rayon mixture); (2) Dependence of the resistance on the state of the water content, viz. temperature and electrolyte content (curves are given for a rayon fabric after washing with tap water and with distilled water); (3) Dependence of resistance on pressure (a curve is given for the above wool/viscose fabric under loads of 1 to 6 kg per 100 sq. cm.); (4) Experiments with the Eicken apparatus, which is adversely criticised.

High Frequency Heating

1605. Alexander, P., Meek, C. A. J.Soc.Dyers & Colorists 66, 530-7
Imp. Coll. Oct. 1950
DRYING BY RADIO FREQUENCY HEATING. Experiments were successful. Woollen fabrics are less liable to damage, dyes were less affected, and material could be dried in thick batches such as a roll. Cotton and rayon successfully dried, but nylon needs great care. The process is very costly. Cost for drying 100 lb. water is £3,000 for generator at 60 K.W. hour power consumption. Total operating costs may be as high as 1d. per lb. water evaporated. For some purposes the gain in speed of drying may make this economical.

1606. Amer. Viscose Corp. B.P. 584,070, 1944
Griffin, F. H.
HIGH FREQUENCY DRYING OF FILAMENTS. 2,000-3,000 volts at 5-60 megacycles is applied to moist filaments under tension conditions to avoid shrinkage. B. 11. 209, Feb. 1951.

1607. Herzog, E. Textil-Rundschau, 1947, 2, 380-383. (In German)
HIGH FREQUENCY AND INFRA-RED DRYING APPARATUS: APPLICATION. A report of a lecture. The applications of high-frequency and infra-red drying are discussed with special reference to textiles, and indications of future developments are given.

1608. Paul, S. T. Proc. 7th Ann. Meeting, U. S. Textile Res. Inst., 1946, 37-38
TEXTILES: INFRA-RED DRYING. A popular comparison of the economics and performance of the infra-red drying method of textiles with the hot air and high-frequency dielectric drying methods.

1609. Reed, H. E. Textile World, 8, 96-7, 1944
HIGH FREQUENCY HEATING APPLICATIONS FOR TEXTILES.

1610. Rusca, R. A. 5th Region Res. Lab. Textile World 1946 96, (5) 118-21, 212, 217, 220, 230
DIELECTRIC HEATING DEVICES: TEXTILE APPLICATIONS. Conclusion:- Dielectric heating has possibilities, but at present is too expensive in initial cost. An electrode was developed based on a principle combining electrostatic stray field and parallel field heating methods, which operated with favorable results on pilot scale with yarn and cloth to evaporate water and solvents and also successfully on resin impregnated cord. 23 References.

Infra-Red Heating

1611. Anon. Textile World 93, (1), 56-58, 1943
INFRA-RED DRYING UNITS: APPLICATION. A battery of 90 - 1000 watt lamps in front of a conventional steam dryer for plush, and other units are described for yarn and with a Sanforising machine. Details of operation and output are given. Increases in production of 25% 400% (yarn) and 16% respectively are reported.

1612. Anon. Rayon Textile Monthly 26, 5, 239-40 1945

Reported that I.R. can be used for sizers, tenter frames, slashers, dryers. Recommended as a booster for the last three.

1613. Anon. Electr. World 128, 138 8. Nov. 1947
CLOTH SWATCHES DRIED IN THREE MINUTES BY INFRA-RED.

1614. Anon. TIBA, 1948, 25, No. 1. 57-58. (In French)
INFRA-RED DRYING DEVICES: TEXTILE APPLICATIONS. A practical account of recent progress under the headings (1) drying of fibres, (2) drying of size, (3) drying of fabrics, (4) resin coatings, and (5) fixation of pigments.

1615. Anon. Kunstseide und Zellwolle, 1948, 26, 171-173. (In German)

INFRA-RED DRYING APPARATUS. The design of infra-red drying plants is based on the reflection and permeability coefficient of the textiles, which is dependent on wave-length, the nature of the fibre, its colour and its weave. Wave-lengths and temperatures are inversely proportional; their ranges and the lamps and heaters to produce them are discussed. An infra-red dryer used over a sizing machine increases the efficiency 2½ times. Other applications are the drying of twines, hemp ropes and yarn, the heating, drying and polymerisation of textiles on conveyor belts, and the pre-drying of printed cotton. (See also: Liga, J. Textile Inst., 1949, 40, A99.)

1616. ---- B.I.O.S. Report No. 514

p. 53. No propane gas or infra-red drying of textiles was seen in Germany.

1617. Carpenter, A. Textile Recorder p. 131, Sept. 1950

DRYING HOSIERY BY INFRA-RED HEATING. Industry's experience has not been very satisfactory. Widespread use has not come about. Material easy to damage and different colours dry at different rates, especially with mixed batches.

1618. Déribéré, M. L'Industrie Textile, 1946, 63, 246-249. (In French)

SIZED WARPS: INFRA-RED DRYING. The author describes a series of experiments, carried out on a semi-industrial scale, in the factory of Etablissements Fauvarque et Cie, Roubaix, France, on the infra-red drying of sized warp, preliminary experiments, the results of which are given, having proved successful. On taking into consideration the good sizing results achieved, the slightly higher cost of this drying method is said to be heavily outweighed by the advantages of this method. Similar results have been achieved in another factory in France, and also in Switzerland. Photographs of the different installations are shown, and references to French publications on this subject are given.

1619. Déribéré, M. Teintex, 1947, 12, 13-15

INFRA-RED DRYING EQUIPMENT: APPLICATIONS IN THE TEXTILE INDUSTRY. Some typical applications of infra-red equipment in the drying of scoured wool, sized yarns, fabrics, and felts, and the heat treatment of impregnated materials are described.

1620. French, C. A., Grapnel, S. L. 1. Textile World 94, 10, 113-5, 1944
2. Textile Recorder 61, 51-2-4-60 1944

1 & 2. Gas fired radiant burners can be used for complete operations by using both radiant heat and products of combustion for convection.
3. Claimed that a large proportion of heat is transferred by convection.

1621. Grapnel, S. L. Textile Research 13, 10.18-28, 1943
INFRA-RED GENERATOR. DRYING EFFICIENCY. As a result of tests made with a gas infra-red ray generator, and as an analysis of the results, it is concluded that the generators of the type tested depend for their drying properties mostly on convected heat, but that further tests are necessary to prove this point. Suggestions for further research are made.

1622. Gregory, J. Jnl. Text. Inst. 21, T 57, 1930
ABSORPTION, TRANSMISSION AND REFLECTION OF RADIANT HEAT BY TEXTILES.

1623. Haighton, V. E. Ltd. and Davies, Glyn B.P. 589,557 of 7/9/1944: 24/6/1947
ANTI-SHRINK RADIANT HEAT DRYING FRAME. Wet cotton fabric is dried on a stenter, without tension, by radiant heat preferably from a block of refractory material heated by gas burners. This mode of drying is claimed to prevent shrinking in subsequent washing processes.

1624. Krupp, P. Textile Rec., Nov. 1945, 63, 45-48
INFRA-RED TEXTILE DRYING APPLIANCES. Illustrations are given of infra-red installations for drying yarns, fabrics, rugs and carpets, already referred to in the discussion of a lecture by Rabold.

1625. Liga Kunstseide u. Zellwolle, 1948, 26, 117-118. (In German)
TEXTILES: INFRA-RED DRYING. The development of infra-red industrial drying since 1934 is reviewed, and present-day applications in the textile industry are discussed. The speed of infra-red drying depends on the thickness of the material. High-frequency drying is preferred for packages, etc., for although more costly, it is independent of the thickness of the goods.

1626. McGlaughlin, F. G. Textile World 93, (10) 88, 1943. Textile Research 13, 12, 21-23, 1943
INFRA-RED GAS GENERATOR. DRYING EFFICIENCY. Writer corrects errors in papers by Grapnel. The quantity of heat received by a wet cloth by radiation depends upon the area of the incandescent surface, depending upon the difference between the 4th powers of the absolute temperatures of the cloth and the burner surfaces, see Grapnel J. Text Inst. 34, A.691, 1943

1627. Paul, G. T. Proc.7th Ann.Meeting U.S.Textile Research Inst.,1946,37-38

TEXTILES: INFRA-RED DRYING. A popular comparison of the economics and performance of the infra-red drying method of textiles with the hot air and high-frequency dielectric drying methods.

1628. Paul, G. T. and Wilhelm, R. H. Textile Research.J.,1948,18,573-597

TEXTILES: RADIATION DRYING. This paper deals with radiation drying of woven and matted wool felts, woven wool crepe and absorbent cotton batting. Radiant energy was supplied by electric lamps, and air conditions at the surface of the samples were controlled. Drying rate curves are analysed in terms of drying mechanisms, and comparisons are made with convection drying by means of heated air. Among the variables discussed are air conditions, air velocity, intensity of radiant energy, sample thickness, optical properties of the materials being dried and the initial regain. There are 21 references to the literature.

1629. Preston and Chen J.Soc.Dyers & Colorists p.364 Dec.1946

SOME ASPECTS OF DRYING AND HEATING TEXTILES. See under subsection "Fundamental Principles".

1630. Rees, W. H., Ogden, L. W. J.Text Inst.37,T113-T120 1946

TEXTILE FABRIC. ABSORPTION AND EMISSION OF RADIATION. EFFECT O COLOUR. The absorption and emission of radiation are studied for colour and body conditions. Effects of dyes of apparently the same colour. Results of for the emissivity and spectrophotometric data are recorded for samples dyed in 15 different colours. At low temperatures a textile fabric of any colour approximates to a black body.

1631. Schneider, J. Melliand Textilber 31,(4)284-6 1950

The use of infra-red was limited in the textile industry and was not adaptable to wool processing.

1632. Selling, H. J. Mededeeling Vezelinstituut T.N.O., No.66,1943(12 pp.)

GREY CLOTH: INFRA-RED DRYING. Experiments have been carried out to determine the influence of infra-red radiation on the breaking stress, elongation at break, and colour of grey cloths of wool, cotton, linen and viscose rayon. Two sets of conditions were used, (1) approximating to industrial drying procedure, and (2) rather more severe heating which raised the temperature of the cloths to 120° C. Experiments were also carried out to determine the effect of varying the intensity of illumination. It was found that this method of drying did not affect the physical properties of the cloths, and fluidity measurements showed that there was no chemical deterioration. Experimental procedure, and the Philips Infra-red Reflector employed, are described in detail.

1633. Selling, H. J. Mededeeling Vezelinstituut T.N.O., No. 66, II, 1944 (8 pp.)
DYED CLOTH: INFRA-RED DRYING. Experiments have been carried out to determine the influence of infra-red irradiation on the breaking stress, elongation at break, and colour of dyed cloths of wool, cotton and viscose rayon. Two sets of conditions were used, (1) approximating to industrial drying procedure, and (2) rather more severe heating which raised the temperature of the cloths to 170° C. It was found that this method of drying did not affect the physical properties of the cloths, and even the least light-fast dye deteriorated slightly less than when the cloth was air-dried under similar temperature conditions. Experimental procedure is described in detail, and a tint-diagram, with trichromatic coefficients is appended.

1634. Shah, N. H. Indian Textile J., 56, 1016-1020 1946
RADIANT HEAT DRYING APPLIANCES: ADVANTAGES. The advantages of infra-red gas and electric burners in drying textiles are discussed from practical and theoretical viewpoints in relation to water evaporation, operation speed, and fuel consumption. On the whole, the modern infra-red gas burners appear to be more practical and economical than electricity as a source of heat.

1635. Kampen, Van Rayon Textile Monthly 24, 431-2 1943
RADIANT HEAT FINISHING AND DRYING PLANT: APPLICATION.

1636. Ware Shoals Mfg. Co. Textile World, 1944 94, No. 3, 83
S. Caroline
INFRA-RED DRYING LAMPS: APPLICATION IN SIZING.

1637. Westbrook, F. A. Textile Manufacturer, 1946, 72, 589-590
INFRA-RED HEATING APPLIANCES: APPLICATION FOR DRYING. The use of infra-red (radiant) heating to augment the drying capacity of steam-heated equipment has resulted in production increases of 25 to 50 per cent. A number of examples of successful applications of electric lamps and radiant gas burners is considered. In one case three banks of six 500-watt infra-red lamps have been installed on a conventional five-can rayon warp sizing machine. In another plant the drying of each colour after the application of dye in printing cloth bags was accelerated by 50 per cent. by adding infra-red lamps to supplement the steam heat of an otherwise satisfactory machine. Other cases include the fitting of three banks of infra-red lamps in front of a calender, the use of radiant heat gas burners with tenter dryers and with automatic control instruments, gas infra-red generators installed on tape frames, and the use of gas burners for singeing.

1638. Wiggs, G. L. Heat.Pip.Air Condit., Mar. 1947, 19, 75-78
RADIANT PANEL HEATING SYSTEM SOLVES TEXTILE PLANT PROBLEMS. An original application of the radiant panel-heating method to solve certain problems peculiar to the textile industry is described.

1639. Wilhelm, R. H. Textile Research, 1944, 14, 400-401
TEXTILE MATERIALS: RADIANT HEAT DRYING. An abstract is given of a progress report on studies of the radiant drying of woven wool felt and absorbent cotton. The course of drying was found to be closely similar in radiant and air-convection drying. In each case, two major periods are clearly distinguishable on a rate/regain diagram. In the first period, free water capable of being centrifuged from the material, is dried at a relatively rapid rate, and in the latter, water held in the fibres is removed by a slower, diffusion mechanism. The rate of radiant drying is greater than that of convection air drying in each period. A theoretical equation has been developed for a heat balance and for the rate of radiant heat drying of textiles in the free-water period.
A stream of air at room temperature passed over material being drie by radiant heat does not materially decrease the rate of drying, but does lower the temperature of the work to a significant extent.

1640. Wilhelm, R. H. and Smith, J. B. Textile Research J., 1949, 19, 73-88
TEXTILE MATERIALS: TRANSMITTANCE, REFLECTANCE AND ABSORPTANCE OF NEAR INFRA-RED RADIATION. Results are reported of a study of the transmittance of near infra-red radiation, with a wave-length maximum at 9.700 A, through layers of textile fabrics, including cotton, viscose rayon, cellulose acetate rayon, and woollen and worsted materials. An R.40 drying lamp was used as an infra-red source and a thallium sulphide photo-conductance cell as the detector. Variables were type of fibre, thickness of textile pile weight and construction of fabric, moisture content, and presence of dyes. A theory of transmission based upon Stokes' equations fo the optics of a pile parallel plates was found to describe the experimental data satisfactorily. The theory also leads to reflectance and absorptance formulae which permit the estimation of these properties from constants evaluated in transmittance measurements. Equations were also developed for the transmittance, reflectance, and absorptance of fabrics supported by a surface.

Carpets

1641. Anon. Sheet Metal Worker 38, 94 Sept. 1947
RUG DRYING WITH WARM AIR HEATERS. Illustrations. Diagrams.

1642. ---- R. A., N. Y. 65, 670 1949
Process Heating Co. Inc.
GAS INFRA-RED AND HIGH AIR VELOCITY SYSTEM FOR DRYING AND CURING LATEX BACKING ON CARPETS. Description of conveyor and gas I.R. generator, 4,000 sq. ft./hr. of carpet with heavy latex spray 10,000 sq. ft./hr. of carpet with light latex spray.

Flax. Linen. Ramie

1643. ---- Linen Research 4, 11, 81-84, Nov. 1944
INFRA-RED HEATING. Description of process. Could not compete with steam heated dryers in respect of cost. (See "Linen Research" April 1949).

1644. ---- Linen, Ind. R. A. Rep. No. 67, Aug. 1945
CHEMICAL ASPECTS OF THE ARTIFICIAL DRYING OF FLAX. A REVIEW OF THE LITERATURE. Puts forward the views on the loss in strength caused in flax when the retted straw is artificially dried. Apparently the non cellulose part of the fibre is altered.

1645. ---- B. I. O. S. Report No. 1218
REPORT ON LINEN INDUSTRY IN GERMANY. Page 200. Yarn is usually dried in tunnel dryers under slight tension. It is common practice to dry fabrics in festoon dryers or in lofts. It is preferred to cylinder drying which was stated to impair both finish and colour of bleached fabrics.

1649. Carter, C. Fibres & Fabrics Monthly 1, 5, 160-1 1940
SOME MODERN DEVELOPMENTS IN FLAX SPINNING AND LINEN MANUFACTURE. III. THE MECHANICAL DRYING OF LINEN YARN. 3 Types of mechanical dryers are described:-

1. Marr method.
2. Mather & Platt's System.
3. A Scottish system of hank drying.

1650. Cox, E. G. M.O.S. Flax Cttee. A.C. 9381, Flx. 409, 1947
H.M. Norfolk Flax Establ.

IMPROVED METHOD OF OPERATING DIRECT HEAT DRYERS.

1651. Cox, E. G., Sayles, C. P. M.O.S. Flax Cttee. A.C. 9272-3 Flx. 396 1947

Trial of a Direct Heat Dryer for Retted Flax Straw at the Sussex Flax Mill, Uckfield, on 3.12.1946, and at Pivington Flax Mill, Pluckley, Kent on 17.12.1946.

1652. Univ. Florida Agric. Exp. Stn. U.S. Dep. Comm. O.T.S. Ct.
Cac.-47-6, pp. 121-2 30. Nov. 1948

RAMIE PRODUCTION IN FLORIDA. Sun drying prevented by rain. Mildew occurs after 12 hours if left damp after decortication (no retting). Continuous tunnel drying. No details.

1653. Keig, R. J. B. Linen Ind. Res. Assn. Rep. No. 6. March 1932
INDUSTRIAL DRYING METHODS. A new system of flax drying and flax dryer are suggested.

1656. Matthew, J. A., Reid, V. W., Spencer-Smith, J. L. Linen Ind. R. A. Rep. No. 74, Apr. 1944
Flax Dev. Cttee. 4th Int. Rept.
THE ARTIFICIAL DRYING OF RETTED FLAX STRAW. EFFECT OF DRYING CONDITIONS ON SPINNING QUALITY. Any form of artificial drying causes some deterioration in fibre quality. The effects of various drying conditions are discussed.

1657. Matthew, J. A., Reid, V. W. Linen Ind. R. A. Mem. No. 501, 534
Rep. No. 64, 1941 and 1942 Flax
Dev. Cttee. 4th Int. Rep.
ARTIFICIAL DRYING OF FLAX STRAW. ARTIFICIAL DRYING OF RETTED FLAX STRAW. A critical survey is made of the drying machines and processes, including costs. Results of tests to obtain fundamental data for various conditions. Conditions for removal of water mechanically and in drying equipment.

1659. Pears, J. B. Textile Mfr. 62, No. 737 May 1936
p. 184-5
FLAX DRYING. THEORY AND PRACTICE IN FLAX AND HEMP YARN DRYING. Comparatively simple explanation of factors in yarn drying, and two types of machine for purpose.

1660. Powell, R. W. (N.P.L.) Institute of Fuel. Drying Study, 1951
THE ARTIFICIAL DRYING OF RETTED FLAX STRAW. The various laboratory tests are described relating to the drying of retted flax straw which provided fundamental information for the design of dryers dealing with retted flax straw in quantity. Details are given of two steam heated flax dryers, one in Norfolk and the other in Northern Ireland, and a brief account is included of the development and performance of the direct heat dryers which were later installed in ten British flax mills.

1661. Preston and Matthew, J. A. Linen Industry R.A. Mem. No. 61
Sept. 1929
ON THE MOISTURE RELATIONS OF FLAX. Results of experimental work on the hygroscopic properties of flax.

1662. Preston and Matthew, J. A. J. Text. Inst. 25, 311.T. and 371.T. 1934
L.I.R.A. Memoirs 99 and 100
THE ABSORPTION OF WATER BY LINEN. Part I. Flax yarns. Part II. Fabrics. Methods of measuring absorbency are described and results of experiments are presented.

1663. Selling, H. J. Linen Research 9, (4) April 1949 Vezel
Inst. T.N.O. Delft Report No. 77
Bundles of 8" diameter after retting are centrifuged in a vertical position at 3,000 metres/min. peripheral speed, whereby moisture is reduced from 300% to 35% calculated on dry weight in 3 minutes. Bundles untied, arranged in sheet form and dried by infra-red, preferably at 1.2-1.6 mu. Consumption given. The advantages claimed might be exaggerated but the process is worth consideration.

mpregnated Fabrics

1664. Dunlop, R. Co. Ltd. B.P. 577,982 1/4/1943
Illingworth, J. W.
RESIN TREATED TEXTILE MATERIALS:- DRYING. Claimed that superheated steam dries the resin solution more expeditiously than passing through air at the same temperature. Illustrated by reference to 1,100 denier rayon cord treated with resorcinol formaldehyde solution for the purpose of giving better foundation for the rubber composition.

1665. Pagerie, M. J. Rayon Textile Monthly, 1946, 27, 477-478
RESIN-TREATED FABRICS: DRYING AND CURING. An outline is given of the padding of fabrics with resin pre-condensates, the drying operation in a net or festoon dryer, the precuring on a pin or clip stenter at 200-250^{0}F., and the final curing in a net or festoon box at temperatures up to 350^{0} F., with adequate means for removing the fumes of formaldehyde, etc.

1666. Pagerie, M. J. Rayon Textile Monthly, 1946, 27, 477-478
RESIN-TREATED FABRICS: DRYING AND CURING. An outline is given of the padding of fabrics with resin pre-condensates, the drying operation in a net or festoon dryer, the precuring on a pin or clip stenter at 200-250^{0} F., and the final curing in a net or festoon box at temperatures up to 350^{0} F., with adequate means for removing the fumes of formaldehyde, etc.

1667. Rutovskii, B. N., Levin, A. N. Trudy. Moskov. Khim Tekh. Inst. im. Mendeleeva 7, 49-91 1940 Chem. Abstr. 37, 6763, 1943
IMPREGNATED FABRICS: DRYING. The amount of resin transformed into the insoluble state during drying should not exceed 5-10%. The drying rate curves of impregnated fabrics have no breaks, but decrease continuously. An expression for the drying rate is given. Expts. leading to improved Textolite are described.

Jute

1688. ---- Br. Jute Trade Res. Assn. March 1948.
THE MOISTURE RELATIONS OF JUTE. Include a summary of the literature 15 pages 30 references.

1669. Hermans Inst. v. Cellulos-Onderzuk. Utrecht Nature 164, 4171 628 8 Oct. 1949 Chem. Abs. 44, (5) 2247, 1950
ORIGIN OF HYGROSCOPICITY OF JUTE. The heat of absorption at zero regain is 228 cal/gm. It is about the same for rayon and cotton, and is due to amorphous constituents.

1670. Levine, M. G., Suran, A. A. Nature 166, (4225) Pages 697-8, 21 Oct. 1950
EFFECT OF MOISTURE ON THE FRICTIONAL PROPERTIES OF JUTE FIBRE.

1671. MacMillan, W. G., Sen, M. K. J. Text Inst. 32, 3 p. T45 Textile Mfr. 67, p. 156, May 1941
JUTE FIBRE DENSITY AND SWELLING. Effect of moisture and other liquids.

1672. Powrie, A., Speakman, J. B. J. Text. Inst. 34, T. 77-86 1943
JUTE AND MOISTURE RELATIONS. Adsorption and Desorption isotherms at 25°C were measured for various qualities of jute and were sigmoid in shape. Regain at any particular humidity tends to increase with increasing xylan and lignin content. As would be expected, therefore, the jute of highest quality was found to possess the lowest affinity for water. The work was done on 11 samples of known commercial quality which were analysed for cellulose, xylan content of the cellulose, furfuraldehyde yield and lignin content.

Laundry

1673. ---- New York Amer. Gas Assn. Amer. Standards Assn. 1940 Z. 21-5 Effective 1 Jan. 1941 40 pp. 1 dollar
APPROVAL REQUIREMENTS FOR CLOTHES DRYERS.

1674. ---- Br. Launderers R.A. Bull. 4, No. 18, 1949
AIR RECIRCULATION IN A DRYER. Description and simple diagram of air recirculation. Simplifies ventilation in the laundry room and comfort of workers.

1675. Anon. British Launderers R.A. Bulletin 3, 44-46, Nov. 1943
INFRA-RED HEATING. 2 applications to textiles, both American.

1. Lamps arranged to carbonise wool cloths after drying. 550°F on cloth.
2. Gas burning unit for drying fabric before it is rolled.

1676. Ellis, H. C. B.P. 608,105 of 15/2/1946: 9/9/1948 (Conv. 10/1/1945)
TUMBLER DRUM FABRIC DRYING MACHINE. The machine comprises a perforated tumbler drum rotatable in a long upper chamber on a downward-slanting axis, several zone chambers under and along the upper chamber each provided with air heating and driving means designed to force air through the heater and into the drum, and conduits for receiving the heated air from one zone of the drum and delivering it to the next heating chamber. There are 14 claims and 8 sheets of machine drawings.

1677. Goldthorpe, W. O. Fuel and the Future, 19 M. S. O.
Br. Launderers' R.A. of steam in the
LAUNDERING AND COAL. The efficiency
laundry industry.

g Engr. 10, 42, 115-119, 125-128
1678. Lewis, G. E. H. In Improvements in the Keighley
REORGANISING A LAU Laundry. Auto-thermal feed system.
district Co- sation. Diagrams and calculations.
Flash s

1679. Parker, F. D. and Bellerby, R. J. — Elect. Industr., Apr. 1946, 46, 124-6, 131

DRYING OF DOMESTIC LAUNDRY. The basic requirements of a domestic drying cabinet are discussed and a dual purpose installation described. This consists of a fan and heater unit fitted in a cabinet, with no recirculation of air. The fan unit may be simply altered to give a ventilated storage cupboard, in which circulation is opposite to that of the unit as a drying cabinet.

1680. Rotz, A. von — B.P.595,305 of 18/8/44:2/12/1947 (Conv.4/1/1944); Addition, B.P.595,327 of 22/1/1945:2/12/1944 (Conv.1/5/1944)

LAUNDRY DRYING MACHINE. The machine comprises a rotary, perforated drum for the goods, means for passing heated, filtered air down through the drum and axially disposed carriers within the drum that create air currents across the drum and thus spread out the articles as they tumble down in the drum. The filter consists of a travelling band of fine-mesh metal fabric that serves to carry away flock.

1681. Schumacher — Gas- und Wasserfach 74, No.46-7 Nov.14 1931 p.1049-52 and Nov.21 p.1084-92

LAUNDRY DRYING WITH GAS. Report from Laboratory of Munich Gas Works reviewing various methods of drying of laundered goods, with special reference to use of illuminating gas; theory of evap'n. of water with hot air and combustion gases of heating plants; results of experiments with drying chambers, pressing machines and hand pressing irons; comparative economy of various processes for drying wet wash.

Nylon

1682. Abbot, H. J., Goodings, A. C. — J.Text Inst. 40, T232-246 1949

MOISTURE ABSORPTION, DENSITY AND SWELLING PROPERTIES OF NYLON FILAMENTS.

1683. Hauser, P. M., McLaren, A. D. — Ind.Eng.Chem. 40, p.112, 1948

WATER VAPOUR TRANSMISSION BY NYLON.

1684. Hutton, E. A. and Gartside, Joan — J.Textile Inst., 1949, 40, T.170-174

NYLON: MOISTURE REGAIN. The adsorption and desorption isotherms for nylon have been determined at 25^{0}C.; the curves show a small, but definite hysteresis. The regain at saturation is approximately 8.70 per cent. The adsorptive capacity of nylon decreases with increasing temperature of drying, but subsequent saturation with water vapour restores the normal affinity for water either completely or to a large extent, depending on the drying temperature. See also American Dyestuff Reporter 28_ 198, 1939 and Text. Mnfr. 65 222 1939.

1685. C.I.O.S.Rept.XXXIII-50
SYNTHETIC FIBRE DEVELOPMENTS IN GERMANY. p. 307 - a few details about tunnel drying of the fibre blanket.

1686. B.I.O.S.Rept.No.1359 p.101-129
THE GERMAN RAYON DYEING, PRINTING AND FINISHING INDUSTRY.

1687. Algemneene Kunstzijde, N.V. B.P.620,194,7.1.47.
U.S.11.2.46
DRYING. (RAYON) THREADS IN THE FORM OF PACKAGES. The packages are dried in an evacuated container by passing a heating medium through closed cylinders on which the packages are supported, so that drying occurs from the inside to the outside. Packages near to the walls of the container are rotated periodically so that they receive the same amount of radiated heat from the walls and are dried uniformly. Apparatus is figured. See Dutch patent 65, 105, 1950.

1688. American Viscose Corp. B.P.584,070 of 26/9/194:
(Assignees of F. H. Griffin 7/1/1947(Conv.16/2/1944)
HIGH-FREQUENCY FILAMENT-DRYING DEVICE. Moist filamentary material (e.g. freshly spun and washed rayon yarn or tow) is dried while it moves along a downward path (so as to be under the tension imposed only by its own weight) by running it through a series of terminals connected to an oscillator so that high-frequency currents are induced in the running material.

1689. American Viscose Corp. B.P.581,711 of 8/1/1945:
(Assignees of F. C. Wedler 22/10/1946(Conv.4/3/1944)
RAYON YARN PACKAGES: DRYING BY FREEZING. A method of drying cellulosic products (particularly rayon yarn cakes) comprises freezing the water at about -70^{0}C. (by means of solid carbon dioxide) and then subliming the ice in a high vacuum. Reference is made to the porosity of the product resulting from fast or slow freezing. Quick freezing leaves a very porous product, whereas slow freezing results in fewer but larger pores.

1690. Best-Gordon, H. W. Inst.of Fuel Drying Study March 1951
A NOTE ON THE DRYING OF DYED VISCOSE RAYON CAKES. These cakes present a special problem because a relatively large amount of water is concentrated in a small inaccessible volume. Two forms of dryer are in general use the loft and the tunnel dryer. The relative merits of each are discussed and the possibilities of high frequency heating are indicated. Drying rate curves are presented and the amounts of a water of imbibition for various textile fibres are given.

1691. Bonnet, F. Rayon & Melliand Textile Monthly 17, No. 6
June 1936 p. 372-3

RAYON DRYING. Dry-bulb vs wet-bulb temperature; drying of sized yarns; before U.S. Institute Textile Research.

1692. Coles, W. V. Inst. of Fuel Drying. Study March 1951

CONTINUOUS DRYING OF VISCOSE STAPLE FIBRE. The prime importance of reliability is pointed out. Various types of machine are described and the desirable features of down draft dryers are discussed. Small scale testing of drying characteristics of staple fibre and trials on plant scale are described. Causes and effects of troubles are discussed. Curves of dryer test results are given and equipment well illustrated.

1693. Cotterill, E. J. Text. Inst. 41, P. 9-15 1950

RELATIVE HUMIDITY AND RAYON. The optimum conditions for manipulati of yarns are discussed in relation to the physical properties of rayon.

1694. Hagopan, R. H. Rayon & Synthetic Textiles, 31, p. 33, Nov. 1950

DIELECTRIC HEATING OF RAYON.

1695. Howell, F. K. Am. Soc. Mech. Engrs.-Advance Paper mtg.
Nov. 30-Dec. 4 1936 6 p. 1 supp. plate.
Rayon Textile Monthly 18, (1) & (2) 1937

LATEST FOREIGN DEVELOPMENTS IN CONTINUOUS DRYING OF STAPLE RAYON. Illustrated description of drier designs and processes, which it is hoped, will be of practical interest to those engaged in this branch of textile processing.

1696. Kamei, S. and Sedohara, T. Soc. Chem. Industry, Japan--J. 37, No. 11
Nov. 1934 p. 1453-62; abstract in supp.
binding of same issue p. 657B-68B, German

INVESTIGATION ON DRYING OF SOLIDS; results of experiments on drying of sulphite cellulose for rayon manufacture.

1697. McFarlane, R. A., Wilcock, C. C. J. Soc. Dyers & Colorists, 65, (4) p. 150 Apr. 1949

PREPARATION, DYEING AND FINISHING OF FIBRO FABRICS. Spun-dyed fibro fabrics are from pigmented viscose before spinning. After hydroing, fabrics should be dried and not allowed to lie, unless stored in a cool room at high R.H. Most fabrics are overdried and under too great a warp tension. The result is lack of fullness and of loft. If no control of drying is possible, fabrics should be stored in a conditioned room after drying. It is quicker to condition from high humidity backwards than to condition upwards. Tin drying of fibro fabrics should be avoided unless there is good temperature control. Stove drying and then clip stentering with intermediate conditioning is satisfactory. Steaming on the starter is not sufficient owing to ineffective penetration. Overfed pin stentering is the preferred method and cuts out the intermediate drying process. Heating pipes and gills should be freed from fly periodically. Cool and condition before examination.

1698. Mathieu, A. Rayonne, 1948, 4, No. 5, 91-97 (In French)
RAYON FABRICS: DRYING. The author gives an account of the difficulties inherent in the drying, during finishing, of rayon fabrics, and gives descriptions of modern methods and machines, especially the Haas and Spooner drying machines.

1699. Miller, B. Rayon Textile Monthly 17, No. 9 and 10 Sept. 1936 p. 594-5, and Oct. 670-1
PROGRESS IN CONTROLLED DRYING OF RAYON SKEIN. Over-drying vs under-drying; three types of driers described; some actual comparisons; important results and conclusions.

1700. Mitchell, Koffolt, Withrow Trans. Amer. Inst. Chem. Engs. 1943, 39, 156-171 Chem. Abstr. 1943, 37, 3613[4]
RAYON CAKES: DRYING.
1. Equation derived for drying rates in relation to R.H. and air velocity.
2. Moisture meter of electrical resistance type for measuring the moisture gradient of cake during drying. Charts.
3. Evidence that moisture flow is influenced by internal stresses due to non-uniform drying.
4. The ranges covered for the variables in (1) had no significant influence on the chemical and physical properties of the dried yarn.

1701. Pennenkamp, O. Zellwolle, Kunstseide, Seide, 1940, 45, 247-250. (In German)
RAYON FABRIC DRYING MACHINES. The development of cloth drying machines is traced and machines of the most recent German construction (1939) for the drying of rayon and staple rayon fabrics are described and illustrated, particularly the cloth-drier system Haas and the Imperial-Zig-Zag-Drier.

1702. Radio Corp. of America B.P. 629,979 15/7/47
DRYING OF RAYON CAKE BY DI-ELECTRIC HEATING. The cakes are dried under a vacuum of 28-29" Hg. at which the temperature is too low to affect the fibre. Drying of a 1 lb. cake (dry weightL is complete in 1 hour using 1.2 K W. Arrangements are made for change in impedance during drying, and for making the process continuous are described, C.f. B.P. 563,590.

1703. Simons, Koffolt, Withrow Trans. Amer. Inst. Chem. Engrs. 1943 39, 133-55-169 Chem. Abstr. 1943 37, 3612^9 Textile Res. 13, (13) 27-8 1943

RAYON SKEINS: DRYING. Diagram and photograph of wind tunnel dryer. Evidence that properly centrifuged skeins dried out solely under "falling rate" conditions. Derived equation for rate of drying humidity and velocity of air stream. Critical moisture content. Temperatures up to 200°F had no measurable effect on yarn properties, except for excessively long periods at the high temperature.

1704. Spooner, W. W., Atkinson, C. P. Silk & Rayon 22, 1416-18, 1948

ACTION OF DRYING MACHINES. Report of a lecture describing drying machines. Special reference to shrinkage and dimensional stability of spun rayon.

1705. Stevens, R. L. Inst. of Chem. Engrs. Lecture 11.1.1949

Page 19. High Frequency drying of rayon cakes gives much less distortion of threads as compared with ordinary drying (70°C) but has slightly less affinity for dyes thereafter on account of molecular structure, and also reduced power of imbibing water. High frequency drying of thread on drums allows shrinking on drying and so avoids shrinkage after making up.

1706. Story, T. H. Textile World 98, 114-15 Jan. 1948

CAKE DRYING SPEEDED BY HIGH FREQUENCY CURRENT. Illustrated.

1707. Thomas, F. W. J. Soc. D. & Col. 65, (10) 481 Oct. 1949

THE DRYING OF TEXTILES. The requirements of tensionless drying of rayon fabrics have led to increasing use of tensionless dryers, the chief of which is the festoon dryer, the creeper type or of the Gessner perforated type. In the air lay dryer, the cloth is supported by air jets.

1708. Urquhart, A. R., Eckersall, N. Shirley Inst. Memoirs 11, 75-82 1932 J. Text. Inst. 23, 163T. 1932

THE ADSORPTION OF WATER BY RAYON. Results of experiments on the water adsorption by various rayons at 25°C are presented graphically and in tabular form. 15 References.

1709. Wakeham, H. R. R., Horold, Edith Portas, H. J. India Rubber World 113, 659-662, 721 1946 Chem. Abstr. 40, 2678 1946

TYRE CORDS, MOISTURE RELATIONS. Moisture relations under various conditions, including wheel tests. The rubber prevents rapid loss of moisture even at high temperatures. Investigations are with a wide range of moisture contents.

Silk

1710. Ditton, E. N. — Silk J & Rayon World 13, No. 145 June 20 1936 p. 36-7

DRYING SILK HOSIERY. Comparison of various methods. Before Textile Drying Conference. From Textile Research 1936.

1711. Hutton, E. A. and Gartside, Joan — J. Textile Inst., 1949, 40, T161-T169

SILK: MOISTURE REGAIN. The adsorption and desorption isotherms at 25°C. have been determined for Japanese, Chinese, and Italian silks, both in the gum and after degumming. The degummed silks have a lower regain than the corresponding silks in the gum at all humidities and also show less hysteresis between the adsorption and desorption isotherms. When degummed, the different kinds of silk adsorb water to the same, or nearly the same extent, but in the gum state the adsorption is greater for the Italian silk than for the Japanese and Chinese silks. Slightly lower values were found for the regain of "iso-electric" degummed Japanese silk than for the same silk before treatment. Approximate values for the regain of sericin have been deduced.

Wool

1712. Anon. — Dyer, 1947, 97, 453-455, 513-514

WOOL DYEING AND FINISHING: STEAM ECONOMIES. The following suggestions are made for saving steam:- Fitting detachable covers to open vessels for loose wool dyeing, woollen and worsted piece scouring machines, and to roll-boiling tanks; injecting a current of very hot air into loose wool dyebaths to maintain ebullition; "scouring" wool stock before dyeing with acid milling colours; thoroughly freeing slipe wool from lime before entering into the dyebath. The possibilities of re-using dye liquor and of heating by waste liquor are discussed. It is suggested that rotary presses should be fitted with insulating arrangements.

1713. Advt. — Chem. Eng. News. 27, 27 1965 4/7/1949

After degreasing in 3 changes of Esso Hexane, the solvent is driven out with an inert gas and finally the wool is vacuum dried.

1714. ——— — B. I. O. S. Rept. No. 1327 50 pp.

SURVEY OF WOOL DYEING AND FINISHING TRADES IN GERMANY. p. 12. Tray dryers similar to English. A variety of colours were dried without mixing, 12 compartments each containing 6 drawers 1 machine with 2 men dried 5,000 lbs. in 8 hours. page 14. Hydro extracted after dyeing, back-washed and dried over steam rollers page 15. Rayon tops hydro-extracted and dried in tubes with hot air blown through. Page 19. A continuous dryer with hot air was inefficient.

1715. F.I.A.T. Report No.546
DRYING OF SCOURED WOOL.

1716. Arend, A. G. Wool Rev., 1947, 21, No.316, 17
WOOL: RESEARCHES IN DRYING. A short account of the use of recording resistance thermometers on wool drying machines, and of an experimental apparatus for drying wool after scouring, using indirect heat in the form of continuously-dried calcium chloride.

1717. Baird Associates Rayon, 1946, 27, 623
WOOL: RAPID MOISTURE DETERMINATION. In a self-contained, forced draught drier, four individual chambers permit simultaneous drying of four samples of 400 g. each. Temperature is controlled to within 2° C., and rotary pumps force 13 cubic ft. of air per minute through the sample. Samples with 60 per cent. regain are dried in 30 minutes. The moisture-laden air is driven off through a vent at the top of the apparatus.

1718. Barker and Marsh Engineering 1932 134, 493
CONTROLLED HUMIDITY IN WOOLLEN AND WORSTED MILLS.

1719. Baxter, S. J. Text. Inst. 37, T39-57 1946
HEAT AND WATER VAPOUR TRANSFER THROUGH FABRICS. An experimental investigation into the heat losses form a dry and wet cylinder of approximately human body temperature, the cylinder being uncovered, and covered with layers of fabric. Diffusion coefficients of water vapour through wool fibres was estimated, and found to be in agreement with direct measurement using Keratin membranes.

1720 Brauckhoff, H. Biochem. Z., 1944, 317, 159, via Chem. Abs., 1946, 40, 939. 20 February, 1946
CHANGES IN CONDITION OF NORMAL, DRY, AND STRETCHED HAIR IN RELATION TO THE RELATIVE HUMIDITY. Normal hair extends within the whole range of relative humidity by about 1.7 - 2.0 per cent. of its original length. The longitudinal swelling is independent of the thickness or colour, but fine hair undergoes alterations quicker than thick hair. Drying always causes a degenerative change in the hair, which is shown in a lengthening which depends upon the degree and duration of the desiccation, but not upon the load. Above 80 per cent R.H., regeneration occurs and becomes complete in saturated moist air. The degenerative alteration is analogous to the changes resulting from mechanical stretching in that, in each case, the lengthening is associated with a contraction of the cross section and with complete reversibility when the overstretched hair is placed in water or in moisture-saturated air. This can be observed even in hair which is stretched more than 30 per cent., which regains practically the original length at humidities above 80 per cent. Obviously, these phenomena are due to intramolecular processes.

1721. Camposortega, C., Morcada, F., Rowen, J. W. J.Soc.Chem.Ind.68,118-9,1949

IS THE ADSORPTION OF WATER VAPOUR BY WOOL PHOTOSENSITIVE

Answer. The effect is due to a factor of a nature not yet recognised. Experts give negative results, no reversible action being observed. See also Bright and Carson, J.S.C.I. 65, 258-9, 1946. (Results are not reproducible)

1722. Cassie, A. B. D. Wool Inds.R.A.Rep.Nov.1944

ABSORPTION OF WATER BY WOOL. The absorption - desorption hysteresis phenomena of wool suggests that this is largely due to mechanical hysteresis of the fibres. Trans. Forad. Soc. 1945,458.

1723. Cassie, A. B. D. Proc.3rd Textile Teachers 1945, 23-29

REGAIN OF WOOL. The regain, R.H. curve and variation with temperature are described. Hysteresis; Compression of adsorbed water due to mechanical strength of the fibre. It appears that the regain hysteresis is a reflection of the mechanical hysteresis shewn by the fibre. Absorbing mechanism is described and appears to be the attraction of - CO - groups for H_2O. This may account for the surprising stability of regain towards chemical change in the fibre.

1724. ---- Communicated

THE FACTORS PREVENTING USE OF H.F. DRYING FOR WOOL ARE THE HIGH CAPITAL COST OF EQUIPMENT AND THE HIGH COST OF ELECTRICITY COMPARED WITH AN EFFICIENT STEAM HEATED DRYER.

1725. Fisher, E. A. Proc.Roy.Soc.A.103,139-161,1923

SOME MOISTURE RELATIONS OF COLLOIDS. I. A discussion of pore size and the nature of drying, and experimental work on wool as compared with rates of drying of sand and clay. An attempt to explain the vapour pressure relationships of wool on the basis of capillarity.

1726. Fisher, E. A. Proc.Roy.Soc.A.103,164-675,1923

SOME MOISTURE RELATIONS OF COLLOIDS. II. Further observations on the evaporation of water from Wool and Clay. Shrinkage is not demonstrated with wool fabrics, although the results do not rule it out.

1727. Fisher, E. A. Proc.Roy.Soc.A.105,571-582 1924

THE DISCONTINUITY OF THE DRYING PROCESS. 2. Tables of Data. Discussion of the characteristic curves for drying of porous bodies and fabrics. See also under "General Principles".

1728. Fisher, E. A. Barker, G. J.Text.Inst.1927 18,195.T
THE INFLUENCE OF VARIOUS FACTORS ON THE RATE OF DRYING OF WOOLLEN AND WORSTED FABRICS.

1729. Franz, F. Textil Praxis 5,54-58 1950
DRYING WOOL AND WOOL GOODS. The theory and practice of the drying of wool are discussed. Various methods are described, copper cylinder machines, hot air dryers, infra-red and high frequency drying and precautions to avoid damage to the wool.

1730. Gillam, N. W. Text.J.Australia,1946,21,453-457
WOOL: EQUILIBRIUM REGAIN, I; INFLUENCE OF HEAT ON REGAIN PROPERTIES. An investigation of the behaviour of regain under conditions similar to Australian mill storage. The physical properties of wool are changed on heating, resulting in a lowering of regain ("fatigued" wool). Reheating involving additional absorptions and desorptions gives a greater lowering of regain at equilibrium than a continuous heating of the same duration. Wool is more sensitive to fluctuating than to steady conditions. When "fatigued" wool is kept at a humidity above 70 per cent., the effects disappear, but return gradually under summer conditions.

1731. Gillam, N. W. Text.J.Australia,1946,21,535-537
WOOL: EQUILIBRIUM REGAIN, II; INFLUENCE OF ELECTROSTATICS, MECHANICAL STRAINS AND CHEMICAL DAMAGE ON REGAIN PROPERTIES. Treatment with alkali (commercial soda ash) raises the regain value at equilibrium. The effect appears to be permanent and is superimposed on other effects, such as the heat "fatigue." Development of an electrostatic charge increases the equilibrium regain values. Mechanical strain on sliver samples increases the equilibrium regain, this confirming the results of King's tests on single fibres (these Abs., 1929 A573). Sulphated detergents lower the equilibrium regain, the absorption being similar to dye absorption. The effects are usually small.

1732. Gillam, N. W. Text.J.Australia,1946,21,537-538,540
WOOL: EQUILIBRIUM REGAIN III; INFLUENCE OF MILL PROCESSES ON REGAIN PROPERTIES. Scouring wool with soap and soda permanently changes the regain properties. Drying carbonised or uncarbonised wool lowers the equilibrium regain to an extent depending on the temperature and drying efficiency. In carding, the effect on regain of frictional heat is greater than that of electrostatic or mechanical strains.

1733. Gillam, N. W. Text.J.Australia,1946,21,541-542, 615-617
WOOL: EQUILIBRIUM REGAIN, IV; SEASONAL VARIATIONS IN REGAINS UNDER AUSTRALIAN CONDITIONS. The regain of wool at room temperature equilibria varies between 3 and 4 per cent., depending on

prevailing conditions. The regain values are lowered during the hot, dry seasons, but recover to the normal values during the wet, winter months.

1734. Hadley, W. N. B.P. 610,102 of 28/3/1946: 11/10/1948
TEXTILE CONDITIONING PLANT. Loose fibre, a yarn package or cloth is quickly brought to normal regain after drying by passage through a steam chest and immediately into a refrigerator maintained at below 0°F. The plant is described by reference to loose wool and wool strip fabric. The material passes through the cold zone at about 100 yards per minute.

1735. Heddergott, K. Textil-Praxis, 1949, 4, 122-123
DRYING SYSTEMS IN WOOL SCOURING: EFFECTS (MECHANICAL) ON QUALITY AND QUANTITY. Three types of wool dryers are described, viz. the cover (Einband), tier and Mehl dryers. Comparative experiments were carried out with the three machines, using the same wool under identical conditions. The cover type, in which air at the highest temperature was applied to the wettest wool, was found to have an adverse effect on the wool.

1736. Hedges, J. J. Trans. Forad Soc. 1926 22, 178-193,
W. I. R. A. 427-430
THE ABSORPTION OF WATER BY COLLOIDAL FIBRES. Theory and mechanism of absorption of wool fibres, experimental work is described and equilibrium curves are presented. Discussion.

1737. King, G. Trans. Faraday Soc., 1945, 41, 325-332
WOOL AND KERATIN: SORPTION OF VAPOURS. As a direct study of the diffusion of water into wool fibres was found to be impossible, two indirect methods were used, one employing larger molecules, such as alcohols, which diffuse more slowly, the other studying the diffusion of water into horn, which has chemical and physical properties very similar to wool. In all these cases diffusion is the rate-controlling process. The results confirm the conception of a diffusion coefficient which increases with concentration, and show that this leads to the building up of a steep front, which advances through the medium as the absorption proceeds. This does not affect the parabolic form of absorption for semi-infinite media but leads to an approximately linear rate in the case of finite media.

1738. King, G. Trans. Faraday Soc., 1945, 41, 479-487
KERATIN MEMBRANES: PERMEABILITY TO WATER VAPOUR. The rate of diffusion of water vapour through a keratin membrane has been investigated. The diffusion coefficient is shown to be a function of the water concentration and of the temperature, but it is independent to a large extent of the elasticity of the keratin lattice. The apparent reduction in permeability of the membrane due to residual air in the "high pressure" side of the system is explained and calculated.

1739. Lincoln, B. Inst. of Fuel Drying Study. March 1951
THE DRYING OF PACKAGED WOOL. Experiment shews that by forcing hot air through packages of wool yarn instead of over them as is usual, it is possible to reduce drying time and reach a much higher thermal efficiency. With dyed wool the risk of uneven shades is small if the packages are sufficiently hydro-extracted beforehand. 180° F. is the maximum temperature to avoid damage. Power requirement is low.

1740. Lincoln, B. Institute of Fuel Drying Study,
March 1951 D.S.I.R. 6315
DRYING PROBLEMS IN THE WOOL INDUSTRY. Wool water relations and equations for heat balance when drying at wet bulb temperature and under falling rate condition. Loose wool drying. Air passes through the wool layer in conveyor dryers, parallel and counter flow In single layer counter flow dryer, steam consumption is about 1.75 lb./lb. water. In multilayer dryers, steam consumption can be up to 10 lb./lb. Yarn Drying and Worsted Tops. Package drying and heat balance equation. Maximum mechanical separation of water is desirable to prevent dye migration. The drying rate depends on rate of diffusion and of heat conduction. Air recirculation is necessary for reasonable thermal efficiency. The difficulties are being met by through drying of the packages. One quarter to one eighth the time for convection drying. Dye migration must be prevented by effective mechanical water removal beforehand. Cloth Drying and Tentering. Process description and heat balance equation. Capable of high thermal efficiency, 1.98 lb. steam/lb. water evaporated. Tabular analysis of heat consumption. Future Developments. Lagging. Recovery of latent heat from exit air. Directed air movement to overcome stagnant air layer. High velocity and hot air jets. Through drying of packages. Success of this method largely rests on effect on quality. Infra-red. Cannot compete in price with steam-heating. 0.6 to 0.7 KW.H/lb. water is needed. Danger of over-drying. High Frequency. Cost over-rides the advantages except in very special circumstances. Electrical measurement of moisture content is capable of preventing over-drying. Difficult to ensure uniformity of drying inside a tentering machine.

1741. Marsh. M. C. Griffin, London 1935.
CONTROLLED HUMIDITY IN INDUSTRY. 132 pp. 43 Illustr.

1742. Marsh, M. C. J. Text Inst. 1935 26, T187-196
THE EFFECT OF HEAT ON WOOL.

1743. Martindale, J. G. Proc.3rd Textile Teachers Conf. April,1945,39-53

WOOL PROCESSING: EFFECT OF ATMOSPHERIC HUMIDITY. A survey of atmospheric conditions in worsted spinning mills is being undertaken. Bulk of wool is processed at less than 50% R.H. The influence of absorbed moisture on strength, extensibility, flexibility and electrical properties of wool are discussed.

1744. Anon. Soc. Peignage de Tourcoing B.P.578,731 10/7/1946

WOOL DRYING APPARATUS. Material travels between a grid (lower) and a lattice (upper), being blown upward by air blown up through the grid by centrifugal fans. Travel is affected by a blast of air forming a Gifford injector. Drying is effected cold, auxillary heat being used only for furry wools. Shade is unaffected.

1745. Sargent's C. G. Sons Corp. Amer.Wool & Cotton Rep.,1947,61, No.33,102

CONTINUOUS DRYER FOR WOOL. The unit is composed of an automatic feeder which delivers the material to a vibrating chute. The chute, by means of a reciprocating push plate, delivers the wool to the nip of the squeeze rollers, and reduces to a minimum any fibre dropping into the screen except that beneath the rollers. A system of weights and levers gives approximately 10 tons of pressure between the rollers. Latest developments are the substitution of pneumatic and hydraulic control for the weights and levers. Many advantages are claimed for this machine, especially greater production with less labour.

1746. Schulze, R. Waerme,55 No.43 Oct.22 1932 p.736-9

Modern worsted-drying machines; necessity for drying of cloth at low temperature; comparison of driers of older design with modern type with drying in stages and horizontal air supply, showing advantages of latter.

1747. Slade, F. H. Mechanical Handling 36,(13)(14)783-91 855-60,1950

MECHANISATION SPEEDS TEXTILE PROCESSING. Describes machinery for processing and drying wool.

1748. Spooner, W. W. Ind.Heatg.Engr.12,(52)50-52,Feb.1950 Paper to Wool Text Fuel Eff.Conf.at Huddersfield 20.9.1949

DRYING PROCESSES IN THE WOOL TEXTILE INDUSTRY. Concerns heat conservation, by running at as high a temperature as possible and recovering condensate from heaters and recuperation of heat from the dryer moisture. "A system should be possible on bigger machines for collecting the vapour as steam in small volumes instead of as air in big volumes so as to use the vapour easily".

1749. Taylor Wordsworth & Co., Ltd., Text. Rec., 1948, 65, No. 781, 41, 66
"AIR FLOW" WOOL DRYING MACHINE. The wool, carried on a single travelling apron, is subjected to alternate upward and downward currents of heated air during its progress through the machine. The air flow is in the opposite direction to that of the material. A system of fans and heaters ensures that the cold wet wool at the feed end meets the hottest and wettest air, and that the dried wool is delivered from the machine in a cool condition. Perforated screens prevent dust from entering the fans of heaters, and prevent fly from blowing about inside the machine.

1750. Zahn, H. Textil Praxis 5, 7-10, 1950
WOOL. ACTION OF HEAT. The action of heat on (a) air dry wool (b) wool in presence of water and (c) stretched wool in water, are discussed. The results of work by various workers shew that dry wool is much more resistant to heat than damp wool. Dry wool will with-stand 140-150^{0}C for a short time. Theoretical and practical applications of the work are discussed.

ADDENDUM

1753. —— Chem. Tr. Jnl. 129, 3358, 855 12 Oct. 1951
MOISTURE DETERMINATION IN RUBBER (AND OTHER MATERIALS).
U.S. National Bureau of Standards. Referee method developed by M. Tryon. A special apparatus for the Toluene distillation method embodies a capillary attached to the trap, which is filled manometrically when distillation is complete. Use of silicone polymer reverses the water meniscus and ensures complete detachment of the droplets from the glass.

1754. —— Scottish Seaweed R. A. No. 120 Sept. 1949
PREPARATION OF SEAWEED. VI. THE DRYING OF SEAWEED. Results are tabulated of trials with a Williams cutting machine, a Buell rotating dryer and a Roma impact mill.

755. Black, D. B., Duthie, A. J. G. Royal Technical College Glasgow, June 1948

THE DRYING PROPERTIES OF SEAWEED. Continuation of the work by McLean and White described in the Scottish Seaweed R. A. Report No. 92, 1945.

756. Gardner, R. G. Scottish Seaweed R. A. Report No. 145, June 1951

PREPARATION OF SEAWEED. VII. LARGE SCALE DRYING TESTS ON A PEHRSON DUAL-PROCESS TYPE GRASS DRYER. It is reasonable to conclude that under steady conditions, a reasonably good value for specific evaporation will be attained.

757. Godding, R. G. J. Rsh. Dev. 3, 9, 647-657, 1950 Br. Cast Iron R. A., Rsh. Rep. 277

HIGH FREQUENCY HEATING UNITS FOR CORE BAKING. The equipment is described and mode of operation. Its use with various binders is discussed, and results are given for test bakings with urea-formaldehyde resin binders. The effect of water is measured on the rate of heating up and properties of the baked core. General applications of the apparatus in the foundry are discussed.

758. Bryson, A., Pickering, W. F. J. Inst. Fuel 25, 141, 28-30, Jan. 1952

THE DETERMINATION OF MOISTURE IN COAL USING THE KARL FISCHER REAGENT.

759. ---- Bord na Mona Experimental Station Droichheadnua, Dublin

LISTS OF TRANSLATIONS. The 13th list of translations December 1951 includes seven abstracts of translations on peat drying, theoretical and practical, mostly from Russian sources.

760. Keppeler, G. Res. Inst. for Tech. Utilisation of Peat, Hanover

VAN ROGGEN-ROBIN'S PROPOSALS FOR THE PRESSURE DEWATERING OF PEAT. Translation, T. 14, by Ministry of Fuel and Power, 1941.

761. Schmidt, E. Welt-Sonntag 41, p. 7, 14 Oct. 1951

BRICKETTS AUS TORF. in German. New possibilities for fuel. A plant on the edge of the Schleswig-Holstein moors for producing briquettes of about 8% moisture and 4-5000 heat units (c.f. good coal = 6,000 Kg. cal. units). The process is not described but is indicated by the term press-torf. "The secret of quality is a special drying procedure developed by engineers Luhrs and von Hayer at the Schleswig-Holsteinischen Torfbrikett Werke near Idstedt.

1762. Westlin, A. Teknisk Tidskrift 33, 81, 717-723, 15 Sept. 1951

AVVATTNING AV TORF. (THE DRYING OF PEAT). A general account of peat drying, draining, sedimentation, filtering; pressing and hot air drying. Structure and properties of peat.

1763. Westlin, A., Theander, O. Kolloid Zeitschr, 122, 153-163 June 1951

DEWATERING PEAT BY ELECTRO-ENDOSMOSIS. Rates of dehydration an energy requirements are discussed. Bibliography.

1764. Bennett, W. E. World's Paper Trade Review 136, 23
Br. Paper and Board R. A. 1641-1652, 6/12/1951

SOME FOURDRINIER WET END EXPERIMENTS. Attention is drawn to the desirability of being able to predict drainage on the Fourdrinier paper machine from a knowledge of a few machine and stock conditions. Two experiments are reviewed in which drainage and attendant conditions were measured. The problem of analysis of the data requires the separation of the various factors by appropriate statistical techniques. The general lines of work at the British Paper and Board Industry Research Association on the problem are indicated.

1765. Daniell, W. F. Paper Trade Jnl. 131, 22, 278-9, 1950 B. II 428, Apr. 1951

DRYING OF PAPER. The progressive removal of water from the paper web is discussed.

1766. Thomas, F. W. J. Text. Inst. 42, 8, p. 703-p. 716, Aug. 1951

PAST AND PRESENT TRENDS IN TEXTILE DRYING. Early History, Cylinder Drying Machines, Stenter Drying Machines, Roller Dryers, Yarn Drying, Infra-red and radio frequency drying, Present general trends, Discussion. Present trends are emphasis on fuel efficien control of tension, increase in temperatures and instrumentation, packaging processing, direct gas firing, desirability of homogeneo drying.

1767. Lauer, K., Besner, O., Kolloid Zeitsch, 116, 28-33, 1950, B. II 42
Dobberstein, O. Apr. 1951.

CELLULOSE FIBRES. X. Drying. XI. Effect of acid on Drying.

1768. Wahba, M. J. Phys Colloid Chem. 54, 1148-1160, 1950, B. II, 423, Apr. 1951

MOISTURE RELATIONS OF CELLULOSE. II. Heats of wetting of partly saturated viscose rayon and standard cellulose in water. The data are in general agreement with the conclusions of Babbitt concerning the nature of the adsorbed film.

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